Bruneau Subbasin Assessment and Total Maximum Daily Loads of the §303(d) Water Bodies

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ACRONYMS AND GLOSSARY

The acronyms and glossary used in this document are summarized in the following list. The list is only inclusive for those terms used in this Subbasin Assessment.

TERM	***DEFINITION***
BAG	Basin Advisory Group
BRO	Boise Regional Office of Idaho Department of Environmental Quality
BURP	Beneficial Use Reconnaissance Project of IDEQ.
CFU	Colony forming Unit.
CMS	Cubic Meters per Second (m^3/s)
Ephemeral stream	A stream which functions as a drainage channel that is normally dry but carries water in response to storms or annual snowmelt. There is no IDAPA definition. The USBLM describes ephemeral streams as streams that flow for brief periods of time. Many ephemeral streams do not appear on USGS maps as solid blue lines like the perennial streams do.
GIS	Geographic Information System
HUC	Hydrologic Unit Code (USGS designation)
HUC 17050102	Bruneau River Subbasin
HUC 4th Field	subbasin hydrologic unit
HUC 5th Field	Watershed hydrologic unit (a sub component of 4th Field HUCs)
IDAPA	The Idaho Administrative Procedures Act. Rules promulgated by the state of Idaho are referenced by their IDAPA number.
IDL	Idaho Department of Lands
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDWR	Idaho Department of Water Resources
Intermittent stream	IDAPA §58.01.02.003.50 defines intermittent stream(s) as "a stream that has a period of zero flow for at least one week during most years. Where flow records are available, a stream with a 7Q2 (the lowest flow that occurs in seven consecutive days within a two year period) hydrologically based design flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with perennial pools, which create significant aquatic life uses, are not intermittent." USBLM describes intermittent streams as streams that have periodic interruptions in a normal pattern or process. USDAFS describes intermittent streams as streams in contact with the groundwater table that flow only

TERM	*DEFINITION*
	certain times of the year, such as when the groundwater table is high, or when they receive water from springs or from some surface source such as melting snow in mountainous areas. They cease to flow above the streambed when losses from evaporation or seepage exceed the available stream flow (USFS 1997d).
LA	Load allocation. The amount of a pollutant ascribed for nonpoint source industries in a TMDL
LC	Load Capacity. The amount of pollutants that a water body can assimilate and still support the beneficial uses.
Man-made water body	IDAPA §58.01.02.003.57 defines man-made waterways as "canals, flumes, ditches, and similar features, constructed for the purpose of water conveyance."
MOS	Margin of safety in a TMDL
Nonpoint source	Any unconfined and diffuse source of contamination, such as stormwater, snowmelt runoff, or atmospheric pollution. Legally, a nonpoint source of water pollution is any source of water pollution that does not meet the definition of "point source" in §502(14) of the Clean Water Act (USEPA 1997 [p. xii])
NRCS	Natural Resources Conservation Service
NPDES	National Pollution Discharge Elimination System Permit. Issued by USEPA for the state of Idaho.
Perennial stream	A stream that flows year-round in most years. There is no IDAPA definition. USBLM describes perennial streams as streams which have uninterrupted flow from year to year. USFS describes perennial streams as streams that flow continuously throughout the year (permanently) (USFS 1997d).
Point source	Any discernable, confined, or discrete conveyance (pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, vessel, or other floating craft from which pollutants are or may be discharged (USEPA 1997).
QA/QC	Quality Assurance/Quality Control
SBA	Subbasin Assessment
SCC	Soil Conservation Commission
SCD	Soil Conservation District
TFRO	Twin Falls Regional Office of IDEQ
TMDL	Total maximum daily load. The standard formula for a TMDL is TMDL= Loading Capacity= Assimilative Capacity= Point Source Wasteloads+ Nonpoint Source Loads+ Margin of Safety.

TERM	*DEFINITION*
TP	Total Phosphorus
USBLM	United States Bureau of Land Management
USDA/ARS	United States Department of Agriculture/Agriculture Research Service
USEPA	United States Environmental Protection Agency
USDAFS	United States Department of Agriculture Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WLA	Wasteload allocations for point source facilities.
WAG	Watershed Advisory Group

1.0 EXECUTIVE SUMMARY OF THE BRUNEAU RIVER SUBBASIN ASSESSMENT AND TMDL DEVELOPMENT

The Clean Water Act established a process for restoring the nation's water bodies to health. Part of this was the designation of impacted waters by the states, through listing such waters as in §303(d). The 1996 §303(d) list for the state of Idaho (EPA 1996) included 16 segments occurring within the region designated as the Bruneau River Subbasin. Nine segments remain on the 1998 §303(d) list. The Bruneau River Subbasin Assessment and Total Maximum Daily Load (SBA-TMDL) for surface waters of the Hydrological Unit Code 17050102 describes those nine water bodies and 19 pollutants that are listed on the 1998 §303(d) list prepared by the state of Idaho. In addition, two additional pollutant water body combinations are included in the SBA-TMDL. The listed water bodies are considered "water quality limited" and may not meet their beneficial uses as defined by state of Idaho water quality standards. The SBA provides information pertaining to existing and designated beneficial uses. The information in the SBA includes those pollutants and the sources of pollutants that are affecting these beneficial uses. The information was obtained from a variety of sources including monitoring efforts of Idaho Department of Environmental Quality (IDEQ) and other agencies and individuals. The public has also been involved in the development of the SBA-TMDL through a variety of venues. Most notably, public meetings were held within the subbasin at various locations. Principally public meetings were held in the towns of Bruneau and Three Creek.
The general physical and biological characteristics of the Bruneau River Subbasin have a strong influence on the water quality of the subbasin. Land use in the subbasin is predominantly rangeland. Limited irrigated agriculture also exists in the subbasin where water is either pumped from the ground or diverted from the river and tributaries. The major population center of the basin is the Bruneau-Grand View area.

The subbasin contains three different water sources. The first of these is seasonal runoff from the snowpack in the southern mountain region. The second is the thermal aquifer below Bruneau and Grand View, which is part of the Western Snake River Plain Aquifer. The final source is from precipitation events on the unintegrated ephemeral channels of the Bruneau subbasin plateau. These sources affect water quality to varying degrees. The geothermal water from the local thermal aquifer may affect water quality most significantly as the amount of water entering the streams and rivers of the subbasin from the other sources changes seasonally. Ephemeral surface channels can influence the water quality of the river and streams by adding a significant but rare and random pollutant load. However, this influence may only be seen during higher flow periods in the various waterbodies.

The subbasin land forms, vegetation, topography, and precipitation can be defined by two ecoregions. The predominant ecoregion of the subbasin is the Snake River Basin High Desert. The Snake River Basin High Desert ecoregion is predominantly sage-steppe grasslands. Most of the surface streams are intermittent or ephemeral in nature due to low annual precipitation and evaporation. Consequently, limited riparian habitat exists within the subbasin. Those streams that remain perennial usually form from spring sources in the southern mountains of the subbasin or from the thermal aquifer that underlies the town of Bruneau. Along these stream courses some riparian habitats persist.

Sediment is the most common listed pollutant in the subbasin. Sediment was a listed pollutant on all 1998 §303(d) listed waterbodies within the subbasin. Other listed pollutants and stressors include nutrients, low dissolved oxygen, flow, and bacteria. The SBA portion of the SBA-TMDL determines the current amount of a particular pollutant in each of the §303(d) listed water bodies' watersheds. The SBA also determines what impact to the beneficial uses each pollutant may have.

In general, the impacts to the beneficial uses were determined by assessing the biological communities and the limited water chemistry data available. When these two data sets were in agreement with one another, appropriate actions, such as completing a TMDL or delisting the stream, were undertaken.

In general, the water quality of the Bruneau River is very good. Furthermore, limited impacts have occurred in the upstream watersheds. As a result, water quality reflects this. Concentrations of suspended materials (as suspended solids and sediment) are very low throughout the subbasin. However, on a seasonal basis the Bruneau River and other surface waterbodies exceed state water quality standards for a single or multiple pollutant such as excessive nutrients, temperature and/or other pollutants. The temperature exceedances may be due to the influence of the thermal spring waters. These waters form the principle habitat for the endangered species the Bruneau Hot Springsnail. However, in all cases of the §303 (d) listed water bodies, annual average concentrations of total suspended sediment are below 50 mg/L in the subbasin. Although in some cases suspended sediment concentrations did exceed the 80 mg/L daily maximum targets in some samples. However, due to the natural variability of the various systems and the limited samples available for analysis (one sample a month in most cases) limited weight should be given to individual samples. Therefore, IDEQ asserts that the annual average concentration is a more robust measure that reflects the overall conditions of a water body. Although, due to the averaging period constraints of the targets (monthly average and daily maximum) waters with exceedances of theses two averaging periods will be considered for TMDLs even though the annual average concentrations are low. By doing so seasonal components of water quality degradation and critical conditions are more fully addressed. In the case of suspended sediment, the concentration of 50 mg/L TSS monthly average and 80 mg/L daily maximum concentrations have been determined by the National Academy of Science and National Academy of Engineers to provide for protection of aquatic communities and by defacto acceptance by the state of Idaho and USEPA through several TMDLs. However, the bedload sediment (surface fines) in the Three Creek watershed is higher than that of a fully supported creek within the same area while suspended sediments are below the 50/80 mg/L targets. In the Three Creek watersheds surface fines averaged 54 percent, well above a comparison stream's average of 40 percent. As a result, the TMDL for the Three Creek Watershed will require a 44 percent reduction in surface fines (or bedload).

Nutrients are a listed pollutant in the Bruneau River and Jacks Creek segments of the Bruneau River Subbasin. In these reaches it was determined that total phosphorus (TP) can be a limiting nutrient, and that all nutrients may be in excess of USEPA Blue Book recommendations. Therefore, a reduction in TP would provide the greatest reduction in nuisance aquatic vegetation. Background TP concentrations at the beginning of the §303(d) listed segment of the Bruneau River were near 0.023 mg/L annual average; concentrations near the end of the reach annually averaged 0.083 mg/L. Only nonpoint sources and naturally soil-associated phosphorus contribute to this increase in TP concentration as there are no point sources located within the watershed. In the Jacks Creek watershed annual TP concentrations averaged 0.202 mg/L. The United States Environmental Protection Agency has set guidelines for TP concentrations in rivers flowing into lakes and reservoirs. As a result, the Bruneau River and Jacks Creek TP concentration target is set at 0.05 mg/L. A 37.5 percent reduction in TP will be required for nonpoint sources within the Bruneau River Watershed, and a 75.25 percent reduction will be required for point and nonpoint sources in the Jacks Creek watershed in order to meet these targets.

The other listed streams and pollutants in the subbasin, in general, were well below any standard or guideline established for the protection of beneficial uses or were dry for all of (or a majority of) the year. From information gathered for the SBA, it was determined that three of the listed waterbodies should not have been considered water bodies which would have supported beneficial uses and were therefore originally listed in error. For example, Sugar Creek had a U.S. Geological Survey peak flow gauge for ten years. During this period, eight of the ten years peak flow was zero cubic meters per second. The two other creeks (Cougar Creek and Poison Creek) were assessed by the Idaho Department of Fish and Game and the Idaho Department of Environmental Quality (IDEQ) under a Bull Trout Problem Assessment. In the assessment it was determined that the streams were ephemeral and likely did not ever support a fishery. IDEQ Beneficial Use Reconnaissance Project monitoring over the last five years corroborates the ephemeral nature of the streams. The IDEQ has determined, for these streams, that their original listing was in error due to their potential for recreational and aquatic life beneficial uses being nonexistent.

Flow and habitat alteration issues were not discussed in the SBA-TMDL due to current IDEQ policy. It is IDEQ policy that flow and habitat alteration are pollution and therefore not a "TMDLable" pollutants. These forms of pollution will remain on the §303(d) list; however, TMDLs will not be completed on segments listed with altered flow or habitat as a pollutant at this time.

Temperature, under the current standards, is a minor problem in some segments of the Bruneau River Subbasin. However, this is generally considered by the residents of the Bruneau area to be a natural problem. Additionally, in other areas of the state bioassessment data conflicts with concurrent temperature information and water quality standards. This is likely the result of the state's current water quality standards being derived from an outdated understanding of the cold water biota's temperature requirements. Consequently, IDEQ is participating in a regional review of temperature criteria, which is being organized by USEPA Region 10. Following the conclusion of the temperature review, temperature exceedances in the Bruneau River Subbasin will be reassessed and, if needed, a temperature TMDL will be completed.

The following tables summarize the TMDLs to be completed, delayed, or delisting actions as a result of the Bruneau River SBA-TMDL.

Table 1. TMDLS TO BE COMPLETED IN THE BRUNEAU RIVER SUBBASIN

Segment	TMDL-pollutant	TMDL-pollutant	TMDL-pollutant	TMDL-pollutant
Bruneau River	Nutrients - TP			
Jacks Creek	Nutrients -TP	Dissolved Oxygen -TP	Bacteria	Sediment- TSS
Three Creek	Sediment - percent fines			
Clover Creek	Bacteria			
Sugar Valley Wash	Nutrients -TP	Dissolved Oxygen -TP	Bacteria	Sediment- TSS

Table 2. DELISTINGS IN THE BRUNEAU RIVER SUBBASIN

Segment	TMDL-pollutant	TMDL-pollutant
Bruneau River	Sediment	
Hot Creek	Sediment	Bacteria
Clover Creek	Sediment	
Cougar Creek	Sediment	
Poison Creek	Sediment	
Sugar Creek	Sediment	
Wickahoney Creek	Sediment	

Table 3. TMDLS DELAYED IN THE BRUNEAU RIVER SUBBASIN

Segment	TMDL-pollutant	TMDL-pollutant
CJ Strike- Bruneau Arm	Nutrients	Pesticides
Bruneau River	Flow Alteration	Temperature
Jacks Creek	Flow Alteration	Temperature
Wickahoney Creek	Flow Alteration	
Hot Creek	Flow Alteration	

2.0. INTRODUCTION

The Bruneau Subbasin Assessment and Total Maximum Daily Load (SBA-TMDL) describe those water bodies in Hydrologic Unit Code (HUC) 17050102 originally listed on the 1996 §303(d) list of the Clean Water Act. In this HUC, seventeen water bodies were listed in 1996. Two were segments of the Bruneau River. One is a section of the CJ Strike Reservoir known as the Bruneau arm. The remaining segments were tributaries to the Bruneau or Jarbidge Rivers. In the next iteration of the §303(d) listing cycle (1998), seven water bodies were removed from the 1996 §303(d) list. At that time it was determined that the seven water bodies met state standards and their beneficial uses were fully supported. Those water bodies included Mary's Creek, two segments of Sheep Creek, Big Flat Creek, Cherry Creek, Deadwood Creek, and one segment of the Bruneau River. These water bodies will not be covered by this SBA-TMDL. The 1998 delisting of these seven water body segments has been approved by the United State Environmental Protection Agency (USEPA). Upon finalization of this Bruneau River SBA-TMDL, some of the remaining segments will be removed from the §303(d) due to TMDL completion or other factors identified in the SBA-TMDL. Others will be delayed until a later date as described in the following sections of this document (see figure 1 for all 1998 listed water bodies). However, the Bruneau arm of CJ Strike will be incorporated into the upcoming CJ Strike Subbasin Assessment and TMDL due to USEPA in 2004. The assessment and data collection for the Bruneau arm of the reservoir was delayed to better utilize resources for the remainder of the subbasin and in future subbasins. By incorporating the reservoir section of the subbasin into the CJ Strike assessment, which is dominated by reservoir conditions, better data can be collected for the Bruneau arm. This improvement of data collection will arise due to IDEQ monitoring abilities and equipment requirements for a reservoir system being consolidated into one assessment and TMDL.

2.0.1 Identification System

Throughout this SBA-TMDL, the watershed delineation and numbering system (HUCs) developed by the United States Geological Survey (USGS) will be used. This system provides a standard method for describing subbasins and the watersheds within a particular subbasin. The Bruneau River Subbasin corresponds with the fourth field HUC of 17050102. Within this subbasin, 36 watersheds have been delineated as fifth field HUC. Further resolution of subwatersheds (sixth field HUCs) is possible within the HUC system but will not be used in this SBA-TMDL. Figure 2a shows HUC 17050102 in relationship with other surrounding HUCs. Figure 2b shows the Bruneau River Subbasin in relationship with the state of Idaho. Figure 3 shows the 36 watersheds found within the Bruneau River Subbasin. Load allocations will be based upon the land uses identified by Geographic Information System (GIS) in the fifth field HUC watersheds of the subbasin. However, if a stream makes up only a small portion of a watershed's hydrology, a river corridor approach will be taken to set load allocations.

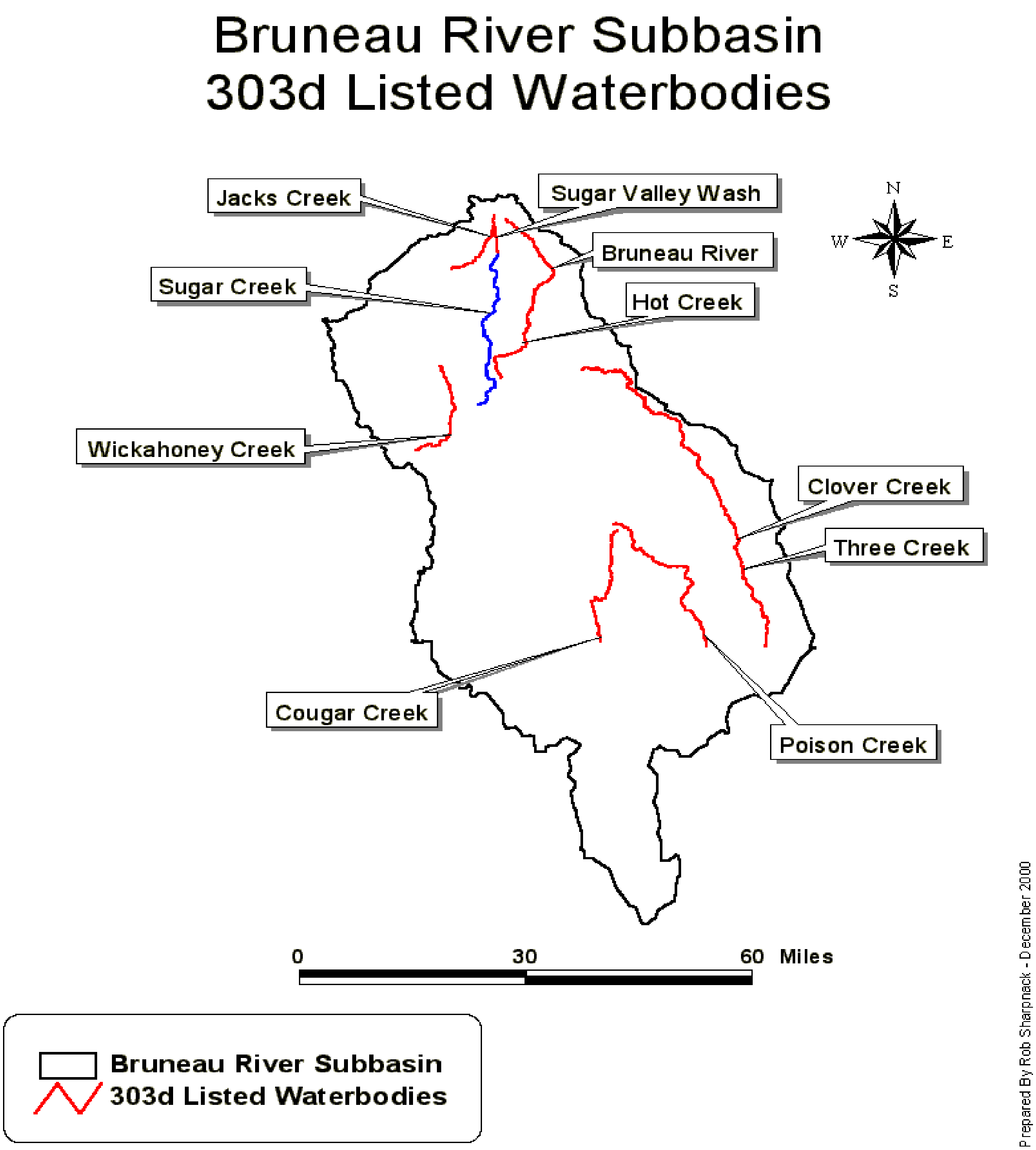


Figure 1. 1998 §303(d) Listed Water Body Locations

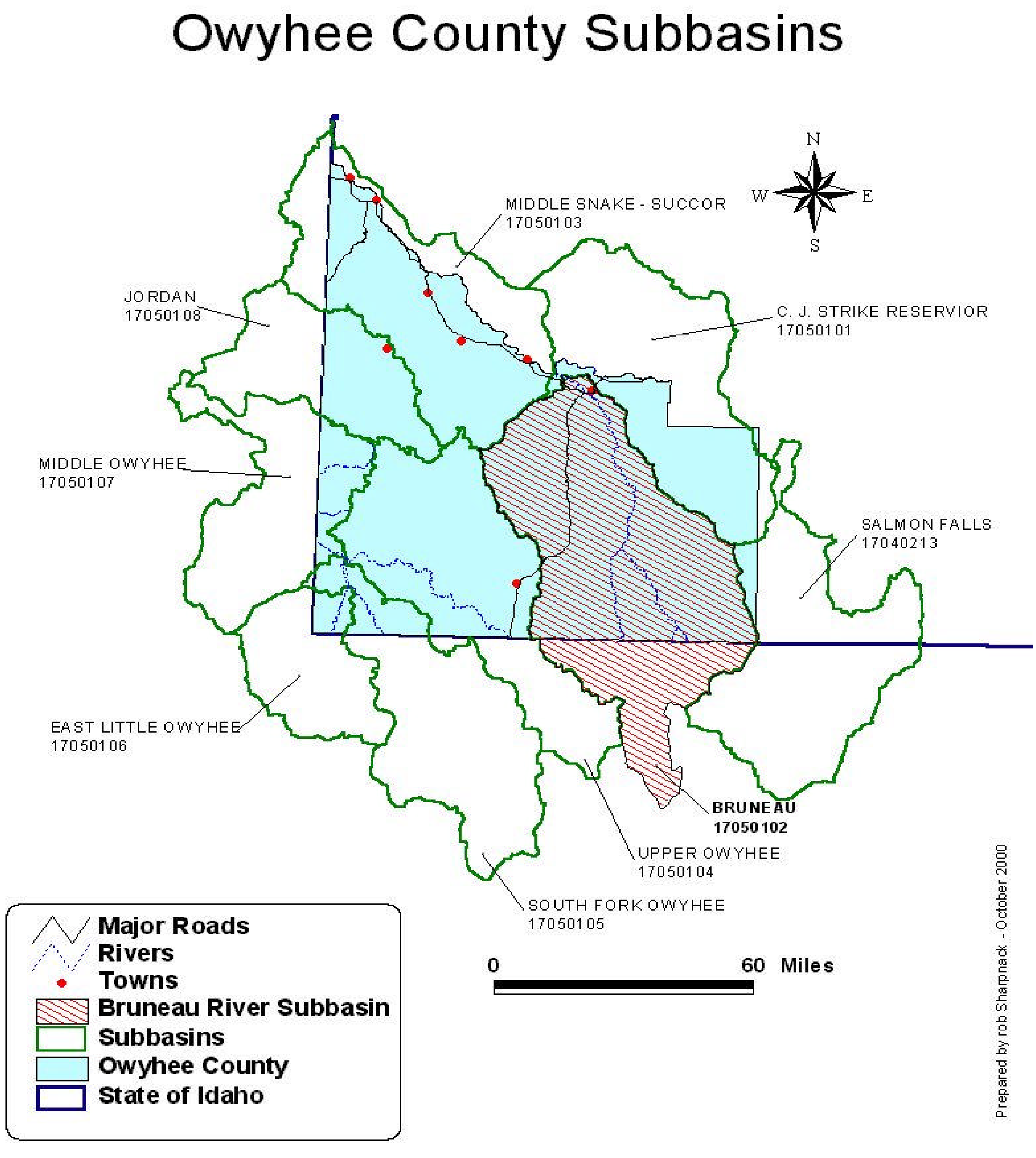


Figure 2a. Bruneau River Subbasin in Relationship with Surrounding subbasins.

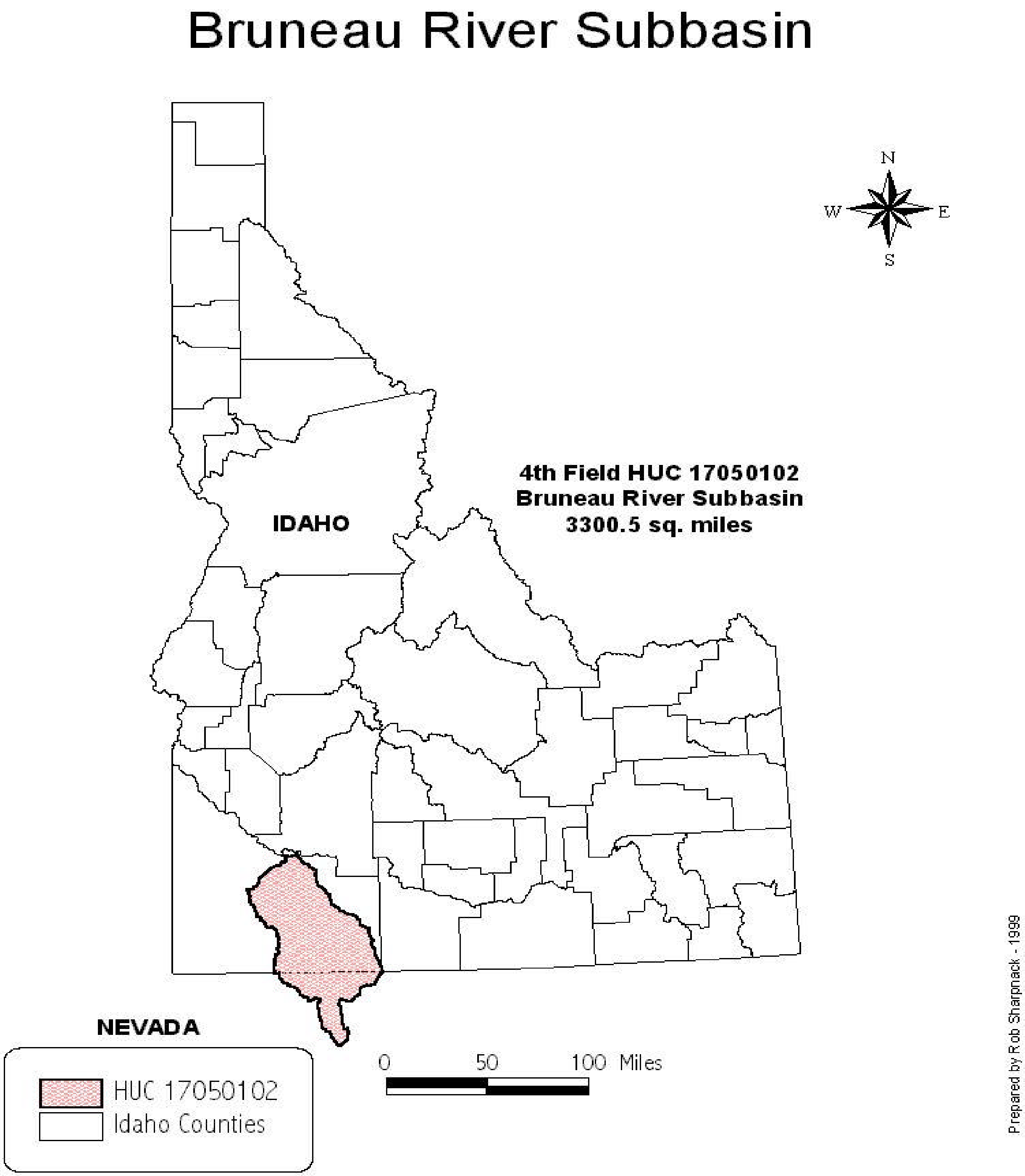


Figure 2b. Bruneau River Subbasin in Relationship with the State of Idaho.

Bruneau River Subbasin Subwatersheds

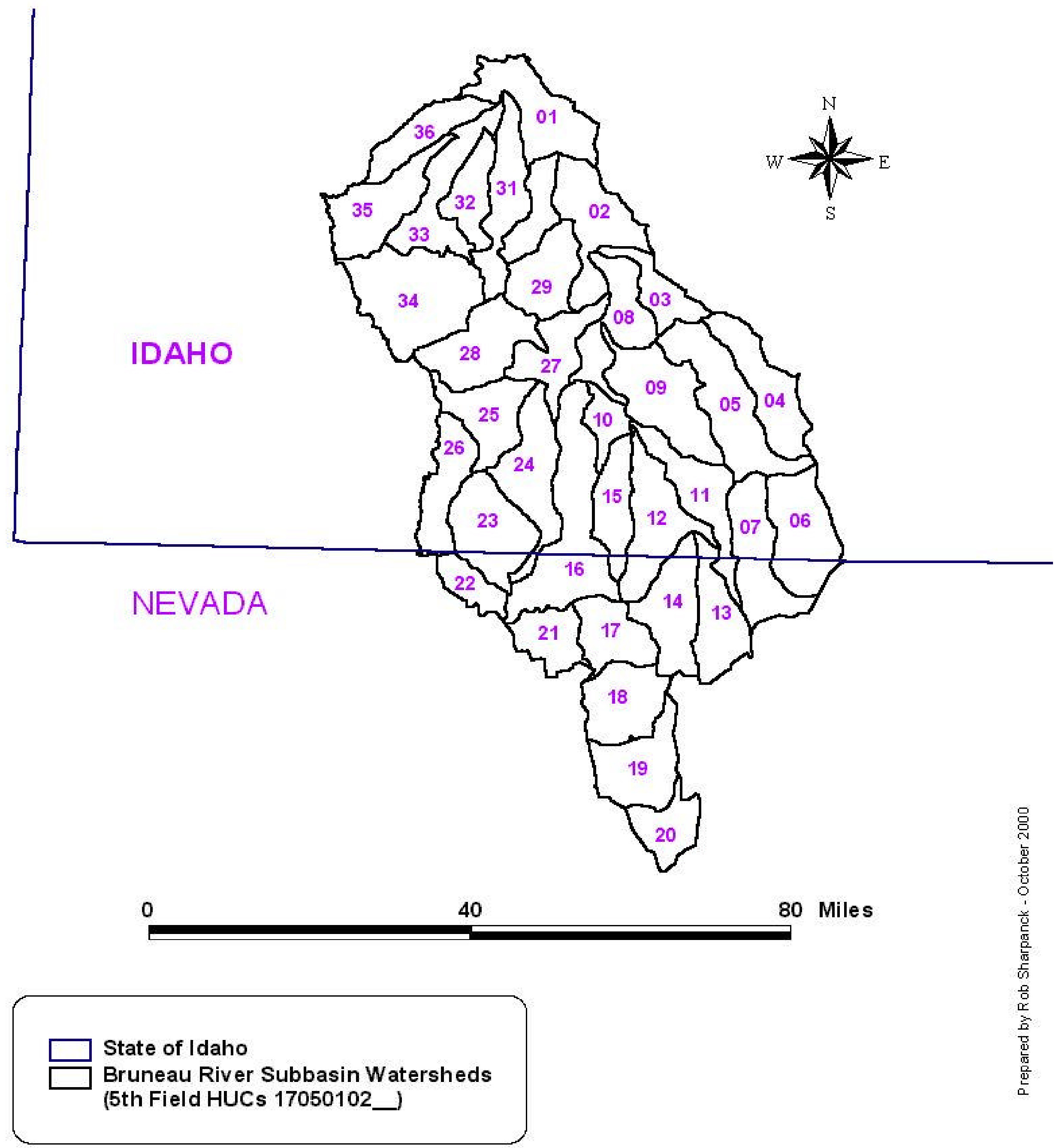


Figure 3. Bruneau River Subbasin Watersheds of Idaho and Nevada.

2.0.2 Compilation of Databases

The development of a SBA-TMDL requires a substantial amount of data collection from sources other than Idaho Department of Environmental Quality (IDEQ). However, data from other sources was very limited in the case of the Bruneau River SBA-TMDL. Those sources, besides IDEQ- Twin Falls Regional Office's (TFRO) ambient water quality monitoring, included USGS, U.S. Fish and Wildlife Service (USFWS), USEPA, U.S. Bureau of Land Management (USBLM), U.S. Department of Agriculture/Agricultural Research Service, Natural Resources Conservation Service, Idaho Department of Fish and Game (IDFG), Idaho Department of Lands (IDL), Idaho Department of Water Resources (IDWR), Idaho Soil Conservation Commission, Bruneau River Soil Conservation District (BR/SCD),and the IDEQ Beneficial Use Reconnaissance Project (BURP) .

The compilation and review of data from these sources focused primarily on assessing the beneficial uses of the rivers and tributaries within the subbasin. Assessments were completed if the rivers and streams had other data associated with them in addition to IDEQ BURP data. However, the focus was primarily on the 1998 §303 (d) listed streams and rivers. Other streams and rivers with no BURP data associated with them will also be addressed in this SBA-TMDL if water quality standards and or beneficial uses are not met. Load allocations and waste load allocations will be based on all available water chemistry data or appropriate surrogate measures. It is expected that where current technology-based controls are inadequate to achieve water quality standards, the implementation of a TMDL will provide more stringent water quality-based controls. The Bruneau River Subbasin TMDLs will be structured on wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety (MOS): where TMDL = WLA + LA + MOS. The MOS will account for scientific uncertainty in the TMDL due to insufficient or poor quality data, lack of understanding in receiving waters assimilative capacity, and the lack of understanding of the effects of pollutant loading rates on the load capacity of receiving waters. The MOS, most often, will be implicit due to a conservative approach taken in determination of load capacity, point and nonpoint source loads, and conservation of pollutants in modeling.

2.0.3 Public Involvement

As envisaged in Idaho's 39-3601 et seq. legislation and Idaho's TMDL process, Watershed Advisory Groups (WAGs) are to be used to encourage public participation. Public involvement for the Bruneau River Subbasin has taken place concurrently with the development of the TMDL. The Basin Advisory Group (BAG) will also provide input into the Bruneau River SBA-TMDL until a functional WAG can be developed.

The Southwest Basin Advisory Group (BAG) provides guidance and advice to IDEQ in the final development of SBAs and TMDLs in the Southwest Basin. Part of this assistance consists of review of the document after formal presentation and providing comments and assistance. The SBA-TMDL was presented to this group on November 2, 2000.

Following public announcements, meetings were held in the Bruneau subbasin to relay progress of the SBA and TMDL process. The first of these meeting was held in the city of Bruneau in February 1999. The Bruneau River area group has not undergone any formal recognition by the BAG and has not undertaken any formal organization into a Watershed Advisory Group (WAG). The group has preferred to stay informal and to use the Soil Conservation District (SCD) as a platform for organization. The group has also decided to provide comments on the progress of the SBA-TMDL through the SCD. Additionally, interested residents from the Three Creek area have met with IDEQ and have been presented information regarding progress and status of the SBA-TMDL.

Local conservation districts began organizing in Idaho in 1940, and are legal subdivisions of state government whose volunteer district supervisors are locally elected. The district supervisors have encouraged participation from their constituents in the Bruneau River SBA-TMDL activities. A single district is within the area of the SBA.

Organized in 1953, the Bruneau River SCD covers approximately 3,000,000 acres in eastern Owyhee County. The main goal of the SCD at that time was to assist each operator in the district with the development of a soil and water conservation plan for his or her operations. The SCD currently has placed irrigation water management, rangeland management, animal waste management, and protection of wildlife habitat as high priorities in its long-range resources conservation program (McBride 2000).

2.1 Characterization of the Watershed

The characterization of the Bruneau River Subbasin will be based on its physical and biological features and how they interplay with the ecoregional and hydrological traits. The Bruneau River Subbasin is complex in its characterization, principally due to a dichotomy of land types within the Idaho portion of the subbasin. The dry, open, and highly accessible plateaus are contrasted by the confined and relatively inaccessible canyons through which the majority of water in the subbasin flows. Additionally, the source for much of the water in the subbasin comes from snowpack and rainfall in the mountain ranges in Nevada to the south. An additional portion of the subbasin complexity is the issue of nonpoint source pollution within the waterbodies, which is affected by soil characteristics, climate, vegetation, topography, and human activities.

2.1.1 Subbasin General Characteristics

As defined by the fourth field HUC system, the Bruneau River Subbasin covers about 8546.96 km^2 in southwestern Idaho and northeastern Nevada and encompasses several water sources.

1. The springs, snowpack, and rainfall in the Jarbidge Mountains and Jarbidge Wilderness area are the major water sources for the Jarbidge river system. The headwaters to the Jarbidge River begin between Fox Creek Peak and Cougar Peak at approximately 2,900 m elevation. While the headwaters of the East Fork of the Jarbidge River begin near Slide Rock Ridge to the north of Mary's River Peak at an elevation of 3,220 m. Both the Jarbidge River and the East Fork of the Jarbidge River enter Idaho at an elevation of approximately 1,640 m.

2. The Bruneau River system begins in a high desert basin bounded by Coyote Mountain (2,201 m elevation) to the east, Mason Mountain (2,277 m) to the west, and Lookout Mountain (2,085 m) to the south. It is formed by springs, snowpack, and rainfall in this area as well as from the Copper Mountains to the east and The Mahoganies to the west. The Bruneau River enters Idaho at an elevation of approximately 1,480 m.

3. Desert tributaries, in general, are the final source of water to the Bruneau River Subbasin. Most of the tributaries are formed on the plateaus and drop steeply in their final few kilometers before their confluence with the major rivers. For example, Deadwood Creek drops over 80 m in the final 3.62 km before it joins the East Fork of the Bruneau River (Clover Creek). Others, such as Mary's Creek drop 160 m in 3.22 km prior to joining Sheep Creek. The majority of these desert tributaries are ephemeral. In the lower elevations of the subbasin, numerous hot springs emerge (Figure 4).

Table 4. ELEVATION RANGES OF THE DIFFERENT WATER BODY TYPES IN THE BRUNEAU RIVER SUBBASIN

Elevation Range (meters)	609.6-914.4	914.4-1219.2	1219.2-1524	1524-1828.8	1828.8-2133.6	2133.6-2438.4	2438.4-2743.2	2743.2-3048	Subbasin Total km
Water Body Type	**Kilometers**								
Ditch	35.1	0.00	0.00	36.97	4.54	0.00	0.00	0.00	76.60
Intermittent	199.51	582.74	1361.12	1894.23	669.1	120.46	12.07	3.57	4842.81
Intermittent Shoreline	0.53	2.22	12.60	17.96	3.83	0.00	0.00	0.00	37.14
Shoreline	28.39	0.00	3.44	13.58	19.60	0.00	0.00	0.00	65.02
Stream	71.62	111.56	230.01	400.34	532.40	195.25	41.70	3.51	1586.38
Total	335.15	696.52	1607.17	2363.08	1229.47	315.71	53.77	7.08	6607.95

2.1.1.2 Wetlands/Riparian Areas

Wetlands and riparian areas are very limited throughout the subbasin. These areas are restricted to the canyon bottoms and along the perennial stream systems. Overall, riparian areas make up only 6.47 percent of the Idaho portion of the subbasin.

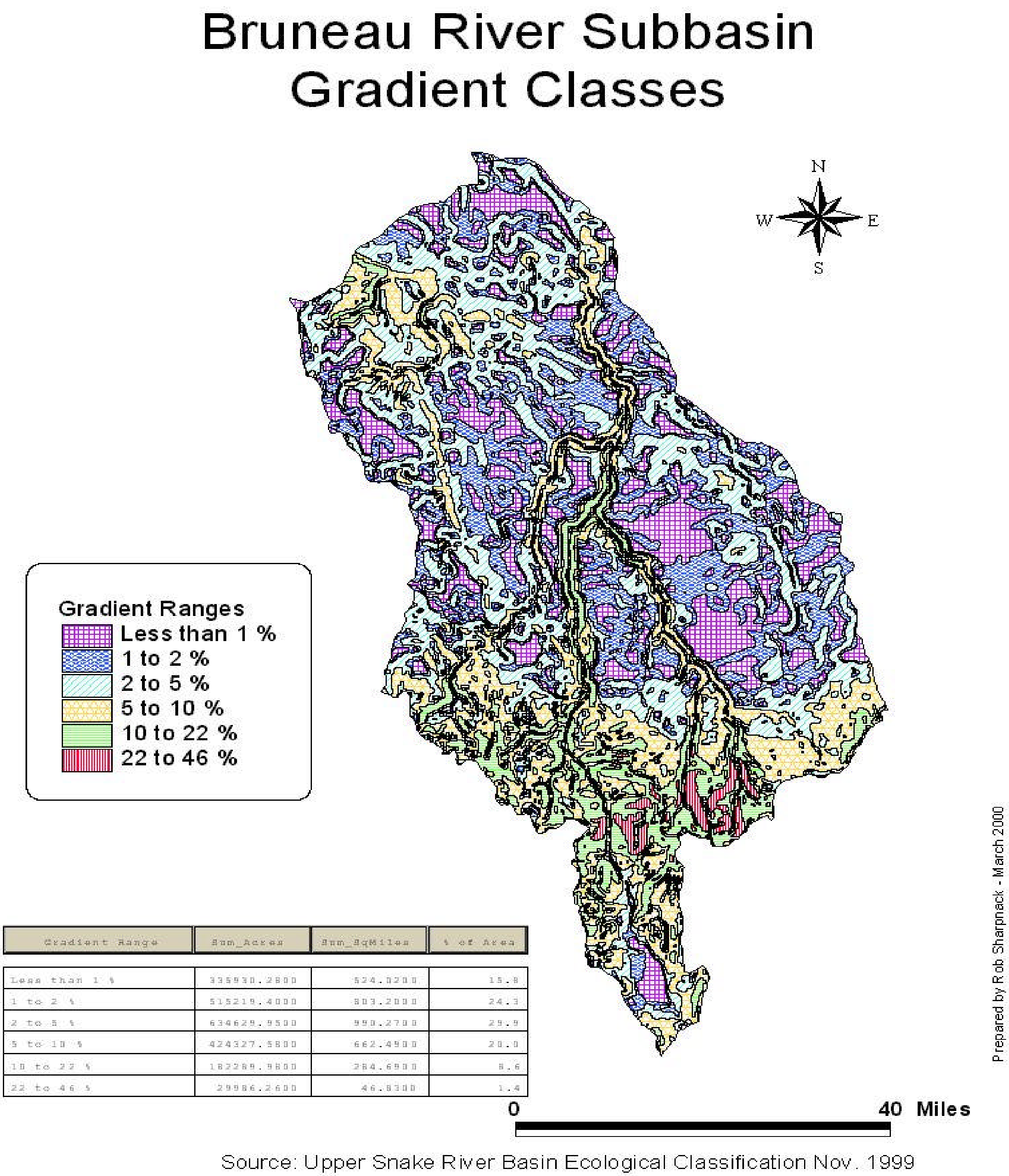
2.1.1.3 Soils/Geology

Local soils can be conceptualized as four soil provinces: the clayey and loamy soils of plateaus, the loamy soils of the fluvial canyons, the highly stratified alluvial soils of the area near the town of Bruneau, and the alpine glacial soils of the Jarbidge mountain province.

The average soil slope provides a gage of potential soil erosion, or risk erodibility. The topographic maps show that slopes are low (0-5 percent) on the plateaus, moderately steeper in the valleys and canyons (5-22 percent), and slopes increase appreciably as one approaches the bordering mountain ranges. The slopes are fairly steep in the mountain ranges, ranging from 10-46 percent (Figure 5.).

The "K-factor" is the soil erodibility factor in the Universal Soil Loss Equation (Wischmeier and Smith 1965). The factor is comprised of four soil properties: texture, organic matter content, soil structure, and permeability. The K-factor values range from 1.0 (most erosive) to 0 (nearly non-erosive). From the Owyhee county soil survey, K-factors on the flat slopes of the plateau soils range from 0.10 to 0.49. However, many of the soil types in this area (namely, soil types Wickahoney, Monasterio, Hat, Clevage, Longcreek, Willhil, Dougal, Bruncan, and Troughs) have K-factors that range from 0.10 to 0.24. On the soils of the main agricultural areas, such as near the town of Bruneau and in the canyon bottoms, K-factors range from 0.15 in the Payncreek soils to 0.49 in the Arbidge and Badlands soils. On the steeper, but rocky, unweathered slopes of the mountains, the erosion potential is low, with K-factors ranging from 0.10 to 0.24. Data from USEPA's modeling tool BASINs calculated area weighted K-factors for the Bruneau subbasin (Figure 6).

In general, the K-factors indicate that the rangelands have low-to-moderate soil erosion potentials. Because of this, sediment sources from the rangelands are also low. Due to the low erosion potential from the uplands, this Bruneau Subbasin TMDL will focus on valley bottom and channel sources of sediment for those streams on the 1998 §303(d) list with sediment as a pollutant.



Gradient Range	Sum_Acres	Sum_SqMiles	% of Area
Less than 1 %	335930.2800	524.0200	15.8
1 to 2 %	515219.4000	803.2000	24.3
2 to 5 %	634629.9500	990.2700	29.9
5 to 10 %	424327.5800	662.4900	20.0
10 to 22 %	182289.9800	284.6900	8.6
22 to 46 %	29986.2600	46.8300	1.4

Figure 5. Gradient Classes of the Bruneau River Subbasin.

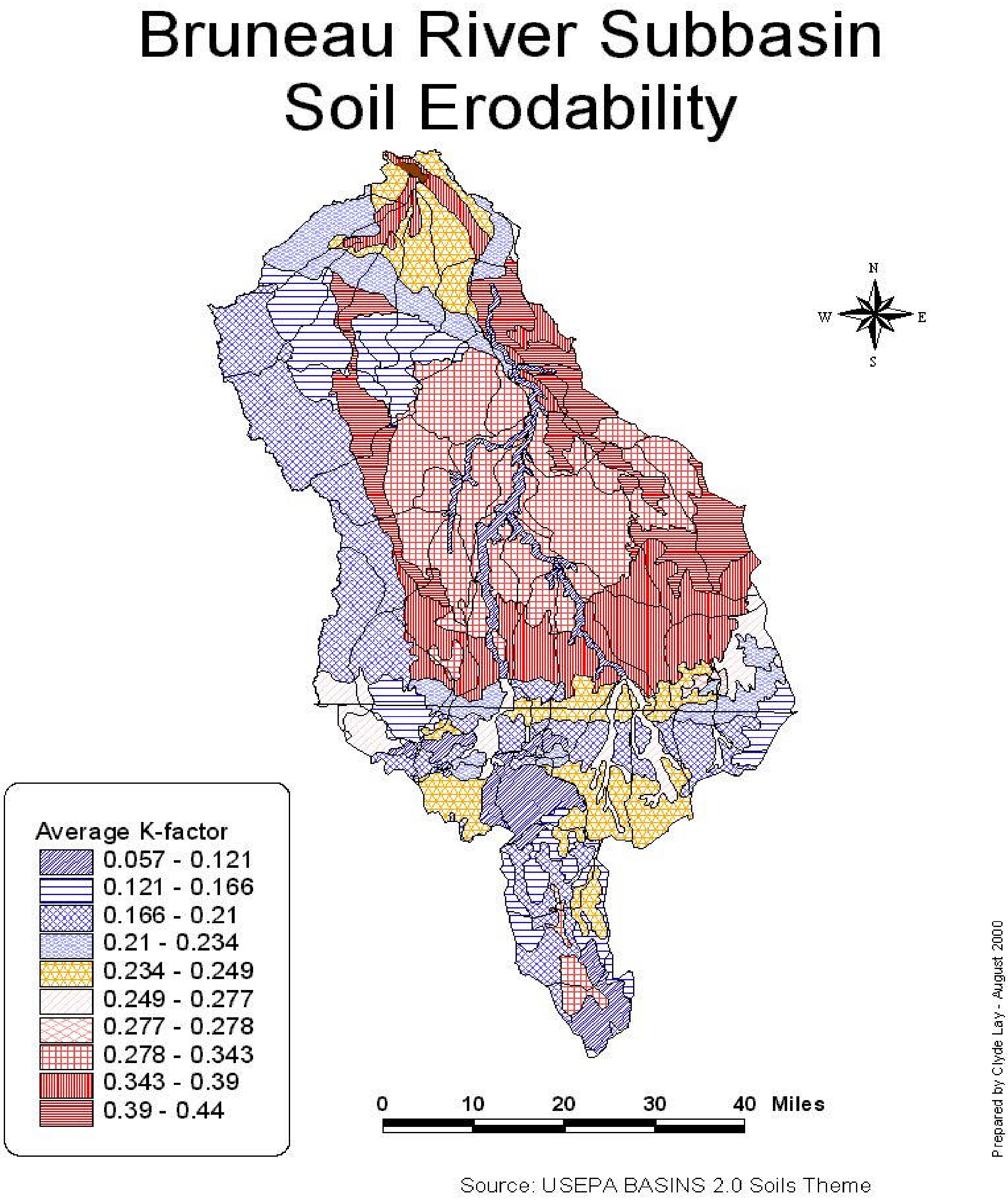


Figure 6. Average K-Factors of the Bruneau River Subbasin.

The overall geologic structure of the area is within the southern extent of the Snake River Plain Province. The Northern Basin and Range ecoregion crosscuts the basin in the south in Nevada. Locally thick deposits of loess (wind-blown silt) overlie these rocks, particularly in the volcanic Snake River Plain (Alt and Hyndman 1989). The Basin and Range is an area of faulted metamorphic and sedimentary rocks uplifted into mountains, separated by basins deeply filled with alluvium. The Snake River Plain is a deep, wide structural basin filled with a veneer of volcanic basalt deposits overlying rhyolite. The rocks decrease in age, from west to east, due to the migration of a magma source that has migrated to present-day Yellowstone National Park.

The geomorphology of the subbasin can be divided into seven geological subsections (Figure 7). Within each of these subsections, locally distinct geological formations can be found. The majority of the subbasin (75 percent including the Nevada portion) lies within the volcanic plateau subsection. Each geological subsection contributes sediment to the streams in various volumes. From Figures 5 and 7 it can be seen that the volcanic plateau subsection likely does not contribute significant sediment loads to the streams and rivers as its slopes are usually less than 5 percent.

2.1.1.4 Ecoregion/Vegetation

The Bruneau River Subbasin is predominantly within the Snake River Basin/High Desert ecological region (Figure 8), as described by Omernik and Gallant (1986) and Omernik (1986).

Most of the perennial streams in the ecoregion are large rivers originating in the adjacent mountainous ecoregion. The small mountain streams become intermittent at lower elevations predominantly due to evaporation and seepage, as well as irrigation and loss of bank storage. Scattered springs occur throughout the region, as do a moderate number of small reservoirs. A majority of the springs are geothermal in nature (see Figure 4).

Sagebrush/wheatgrass/needlegrass steppe is the dominant vegetation type throughout the region. Stands of juniper are also found in this area, as are large tracts of saltbush/greasewood. Some playas and recent lava flows are entirely devoid of vegetation. Streamside vegetation is generally the same as the surrounding regional vegetation due to the intermittent or ephemeral nature of most streams. Where perennial flow does occur, dense stands of sedges and forbs line the riparian zone. In perennial streams with moderate annual flow, woody vegetation consists of alder, willow, cottonwood, clematis, rose and mock orange.

Most of this region is used as rangeland. However, some areas within basins or bordering large streams are irrigated for pasture and production of potatoes, corn, alfalfa, sugar beets, mint, and grains. Where access by livestock is concentrated, loss or reduction of streamside vegetation is severe, causing stream bank erosion and sedimentation. Water withdrawal for irrigation often results in completely dry channels downstream from diversions.

Variability in the makeup of natural vegetation in the Bruneau River reach is minimal. Shrubland and grassland vegetation predominate the entire subbasin (96.6 percent in the Idaho portion) with limited riparian vegetation in the mainstem rivers (0.5 percent of the Idaho portion of the subbasin). Following the construction of irrigation canals and irrigation return drains, some of the natural sage-grass areas have been changed to support agricultural crops, pasture grasses and hay, and riparian vegetation.

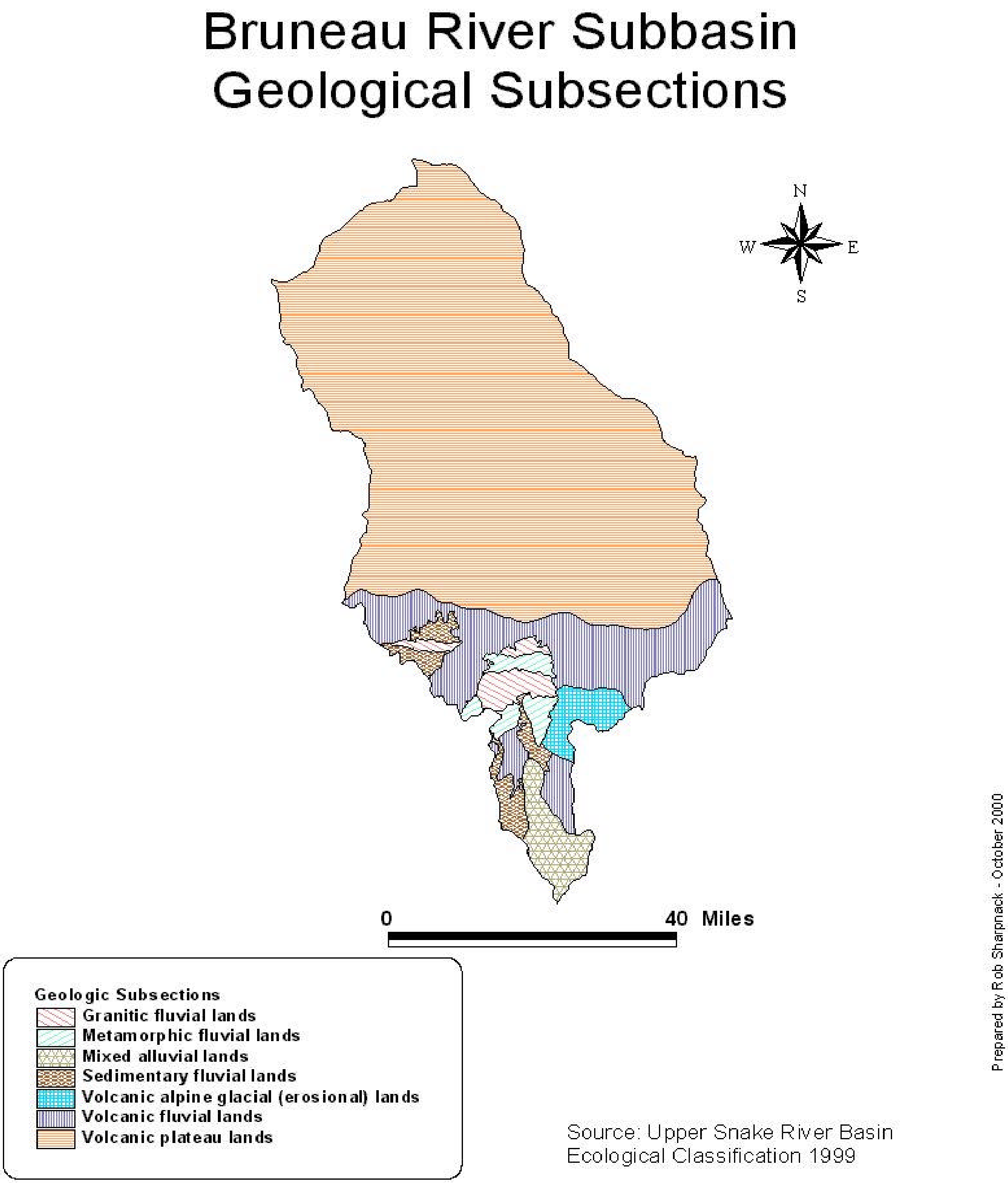


Figure 7. Geological formations of the Bruneau River Subbasin.

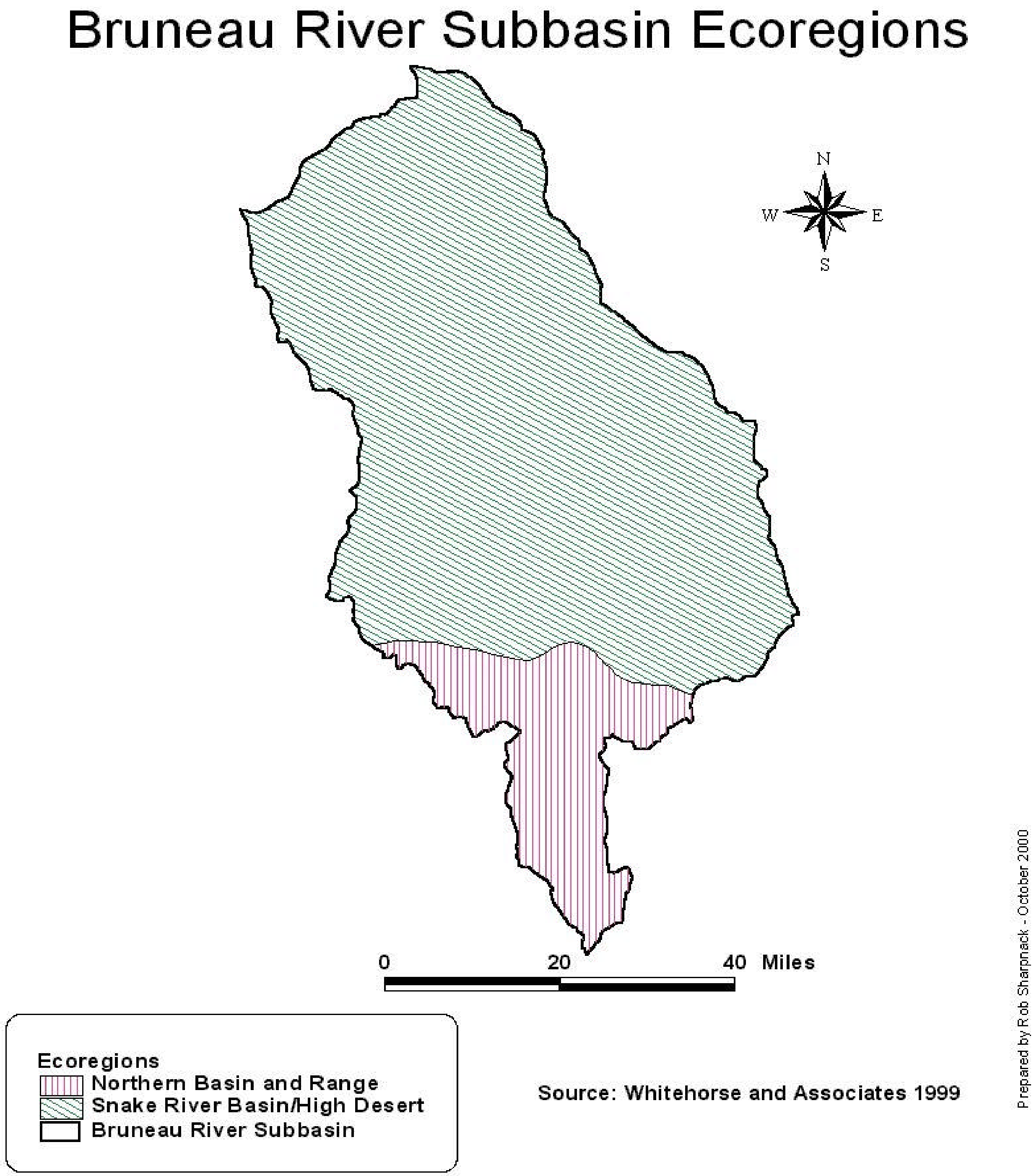


Figure 8. Ecoregions of the Bruneau River Subbasin.

2.1.1.5 Land Use and Ownership

As seen in Figures 9 and 10, and Table 5, more than 90 percent of the lands within the subbasin are used as rangelands. Nearly all the remaining lands are in the confined canyon bottoms, which are classified as riparian areas and water. A very small portion of the subbasin is used for cropland agriculture (2.8 percent), with most of this (63.21 percent) under sprinkler irrigation.

Table 5. LAND USE IN THE BRUNEAU RIVER SUBBASIN (USEPA 1998)

Land Use Type	Percent of Total Area
Range	90.6
Agricultural	2.8
Riparian/Water	6.6

The subbasin in Idaho lies entirely within Owyhee County. Privately owned lands (6.9 percent of the subbasin) are essentially the same lands that are used for agriculture. The majority of the remainder (84.3 percent of the subbasin) is managed by the USBLM. These are treeless rangelands. Scattered state endowment lands (sections 16 and 36), under the management of IDL comprise 5.5 percent of the subbasin. A small portion of the subbasin (1.6 percent) is a military reservation. Another small area in the southwestern portion (in Idaho) of the subbasin lands is part of the Duck Valley Reservation administered by the Shoshone-Piaute Tribe. Highway 51 is the main access through the subbasin. This highway crosses the northern-most portions of the subbasin and heads southbound down the western portion of the subbasin. The only other paved road in the subbasin is the Rogerson cutoff that connects the town of Rogerson and the Three Creek/Murphy Hot Springs area. The remainder of the subbasin is covered with numerous dirt and gravel roads, most of which are not maintained (see Figure 11).

2.1.1.6 Population

The population in Owyhee County was about 8,392 in 1990 (www.idoc.state.id.us 2000) and was estimated at 10,227 in 1998. The majority of the county population lives outside of the subbasin. For example, in 1998, the Homedale and Marsing populations were estimated at 3,311, most other towns were too small to be listed. The Bruneau SCD, which covers most of the subbasin, estimates the population of the district at 2,000 full time residents (McBride 2000). The largest municipality in the subbasin is the town of Bruneau. Other small towns include Grassmere, Three Creek, and Murphy Hot Springs (Figure 12). The underlying foundation for economic activity in the area is agriculture, which is mainly derived from ranching and farming.

Most of the initial agricultural activity in the area was ranching and grazing. Decreed surface water rights for irrigation in the Bruneau area began in 1875, while decreed stock watering rights began in 1860. In the Three Creek area, the first recorded stock water right was in 1871. In 1885, the first irrigation water right was filed.

Recreation is an important water-related industry of the Bruneau River and Jarbidge River reaches. These rivers provide for varied recreational experiences. Whitewater rafting and kayaking occur in the spring during high water. There are several rafting services in the town of Bruneau that ferry rafters to and from launching and takeout points.

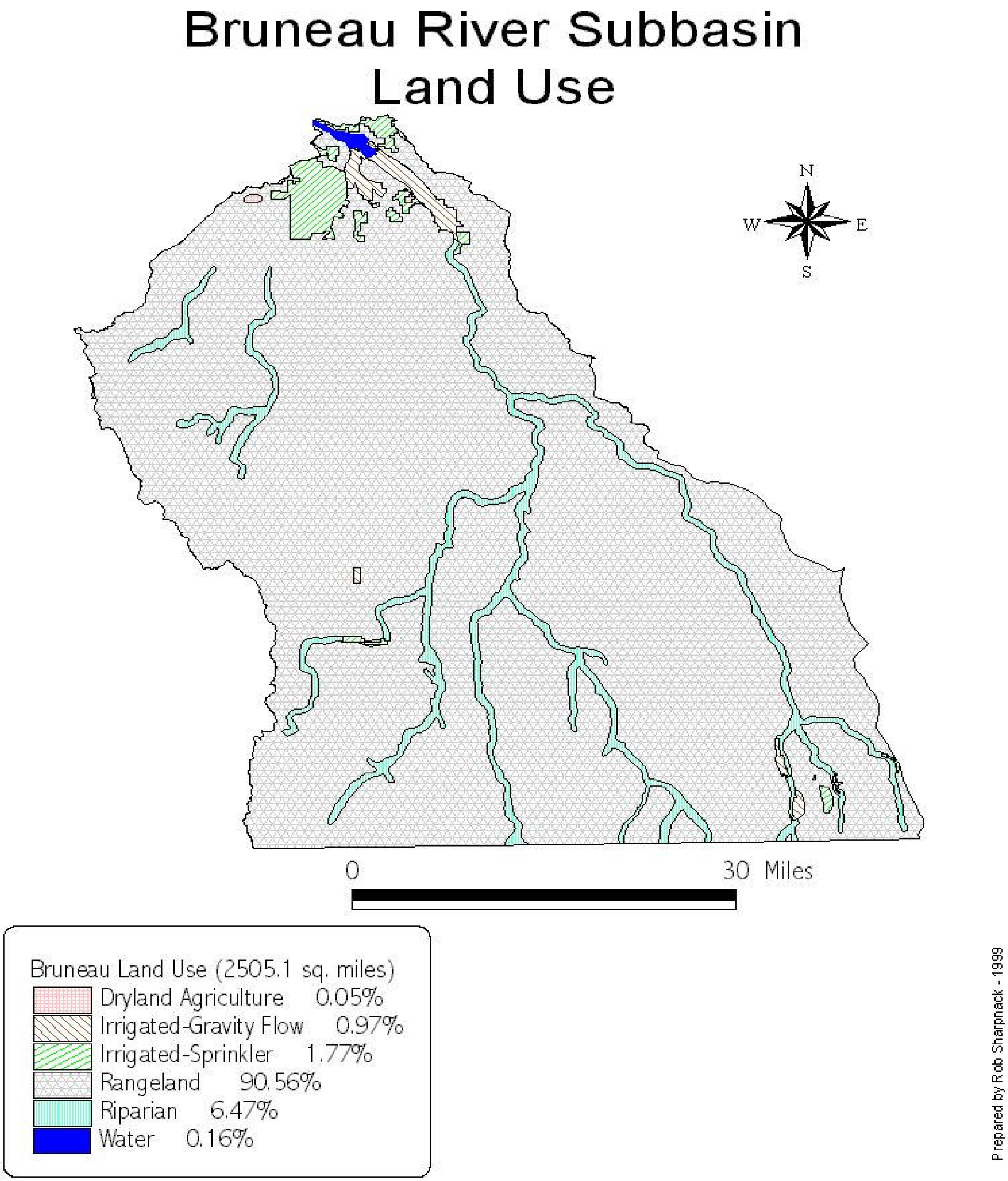


Figure 9. Land use of the Bruneau River Subbasin

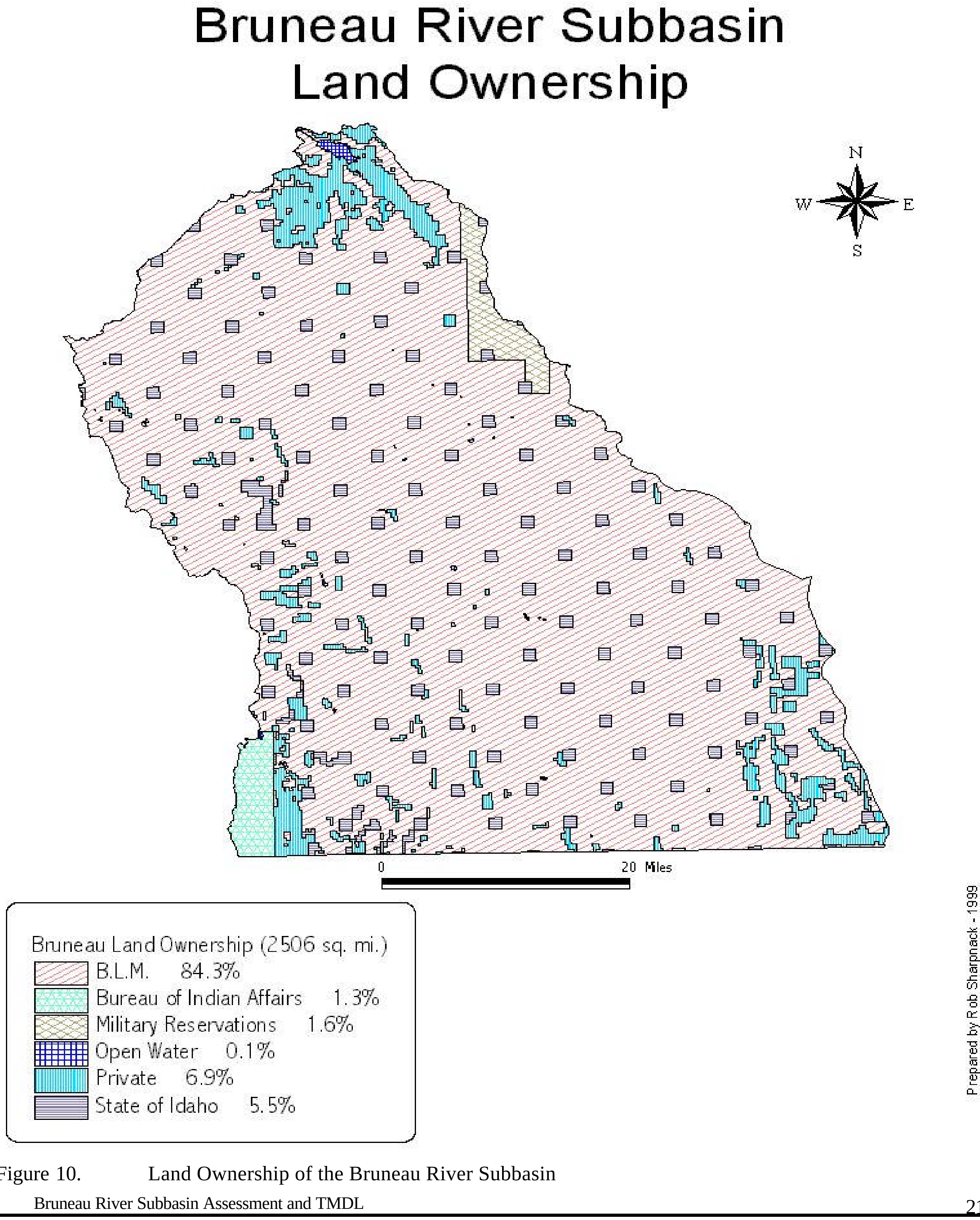


Figure 10. Land Ownership of the Bruneau River Subbasin

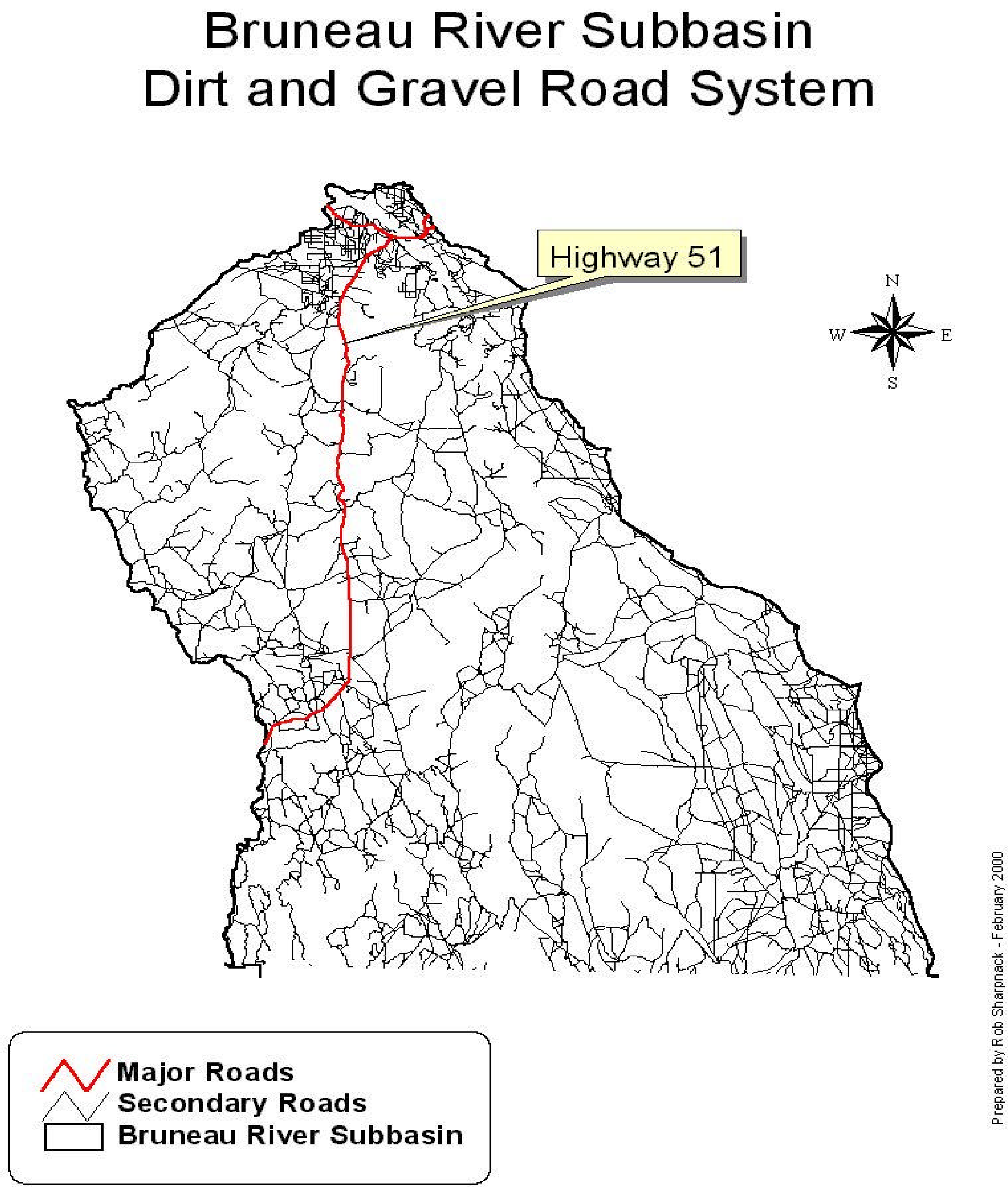


Figure 11. Dirt and Gravel Road System of the Bruneau River Subbasin.

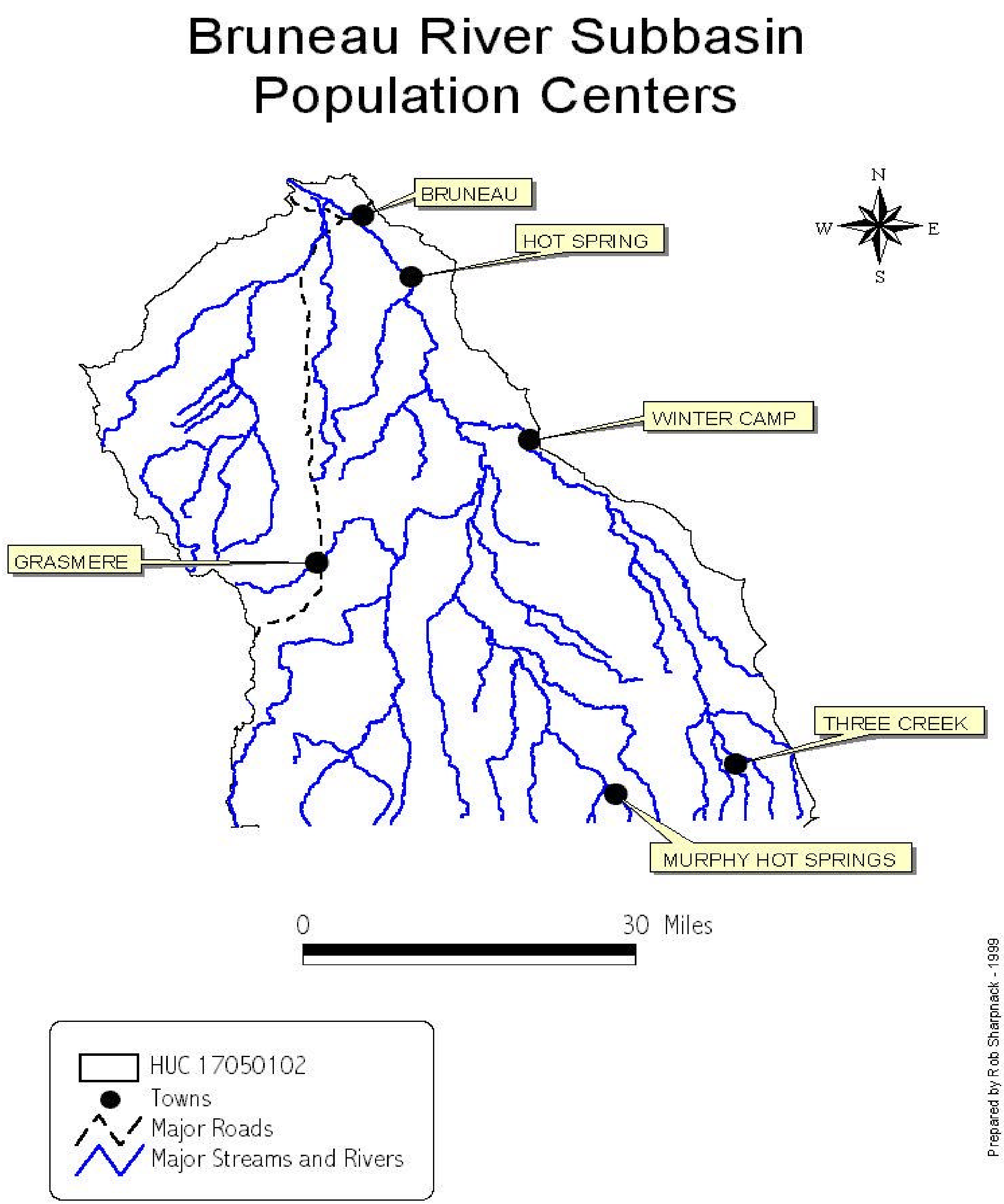


Figure 12. Population Centers of the Bruneau River Subbasin.

2.1.1.7 Climatology: Precipitation and Temperature

As stated previously, the subbasin begins in the high mountains of the Northern Basin and Range geologic province to the south and reaches northward to the lowlands of the Snake River Basin High Desert. Because of the elevation difference across the subbasin, there are pronounced differences in climate from the Snake River Plain to the mountains. Precipitation varies from 8 to 9 inches/year on the lower elevations of the Snake River Plain to 22 to 42 inches/year on the mountain summits (Figure 13). Using the Koeppen system of climate classification, the plains would be classified as BSk or "cold steppes" and the mountains as "undifferentiated highland climates."

Only two climate stations from the Western Regional Climate Center (www.wrcc.dri.edu 2000) are available to characterize the watershed. These are Bruneau and Three Creek. A third, Grassmere, is not available at this time. As a result, there are few data sets available for the bulk of the middle section of the subbasin. As noted, nearly all the perennial flow in this watershed comes from the mountains to the south of the Snake River Plain which do not have climate station data.

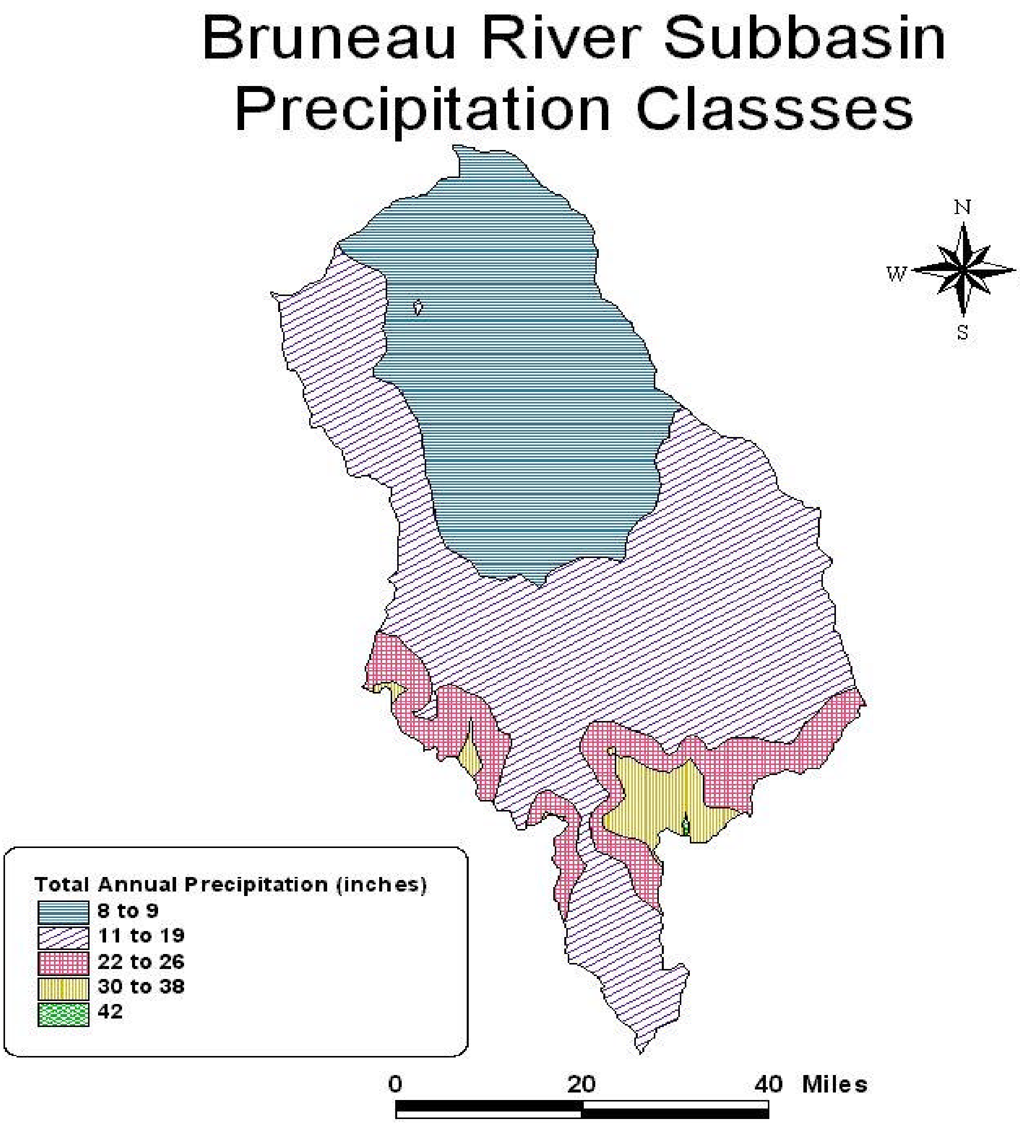
The town of Bruneau is in the southwestern portion of the Snake River Plain at approximately 771 m elevation. The climate is arid with an annual precipitation of 19.28 cm. Over one-fourth the precipitation falls as snow in November to March. Average snow depths in these months is zero, indicating that most precipitation in the form of snow does not accumulate to provide for a spring snowmelt runoff. The wettest months of the year are November and January (2.51and 2.29 cm respectively), while the driest months are July through October (0.46 to 1.24 cm). For the remainder of the year, the mean precipitation is evenly distributed at approximately 1.79 cm a month. The annual temperature is 11.39 °C, with average winter temperatures of 0.83 °C, and average summer temperatures of 22.28 °C.

The town of Grassmere is approximately 64 km south and west of Bruneau in the Snake River plain ecoregion. Grassmere lies at an elevation of 1,563.62 m. It is an arid climate, with an annual mean precipitation of approximately 20-23 cm. The annual temperature is between 7.33 and 9.66°C, with cool winters and warm summers (Figures 14 and 15)

The third permanent weather station is located at Three Creek, and is the closest station to the mountainous area. It lies at the edge of the Snake River Plain at an elevation of 1,652 m. The area is semi-arid with an annual mean precipitation of 32.84 cm, about a third of this as snow. Average snow depths in the winter months ranges from 7.62 to 10.16 cm, indicating that some precipitation in the form of snow accumulates to provide for a spring snowmelt runoff. The wettest months of the year are May and June (4.65 and 4.47cm respectively), while the driest months are July and August (1.32 and 1.4 cm). For the remainder of the year, the mean precipitation is evenly distributed at around 2.54 cm a month. The annual temperature is 6.33°C, with average winter temperatures of –2.33 °C and average summer temperatures of 15.94 °C.

2.1.2 Subbasin Hydrology

Generally, the natural hydrology of an area is related to its climactic regime, topography, and geology. Water in the Bruneau River Subbasin moves through a variety of pathways, dominated by the Bruneau River and Jarbidge River routes. Except for the two mountainous southern drainages, most of the surface channels are intermittent or ephemeral tributaries. Seasonally, groundwater plays an unknown but significant role in the hydrology of several streams and rivers of the subbasin.

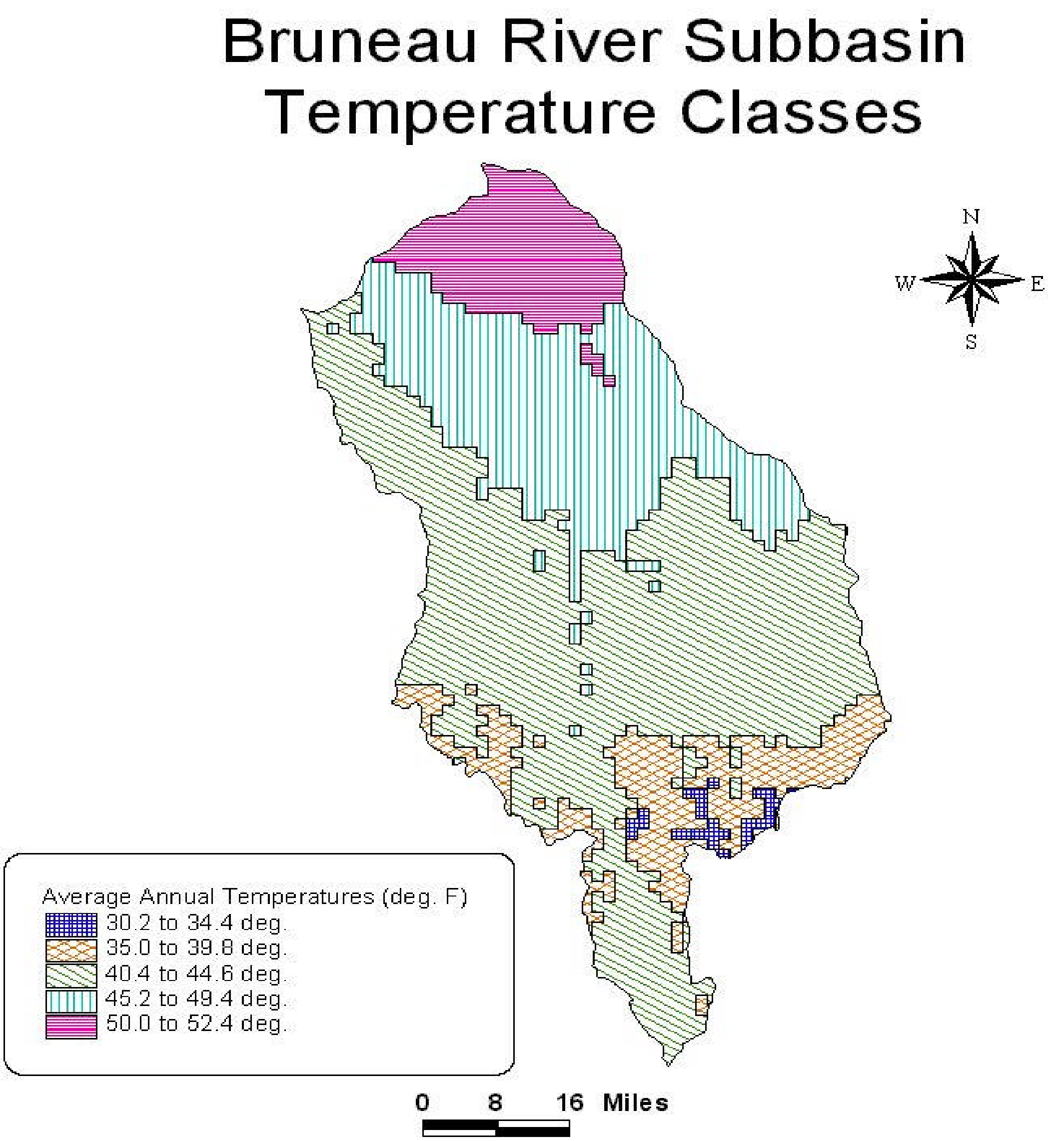


Precip. (in	Acres	Square Mil	% of Area
8 to 9	736362.54	1150.56	34.7
11 to 19	1095828.35	1712.22	51.6
22 to 26	221841.48	346.63	10.5
30 to 38	67611.07	105.63	3.2
42	737.62	1.15	0.0

Prepared by Rob Sharpnack - March 2000

Source: Upper Snake Basin Ecological Classification Nov. 1999

Figure 13. Annual Precipitation Ranges of the Bruneau River Subbasin.

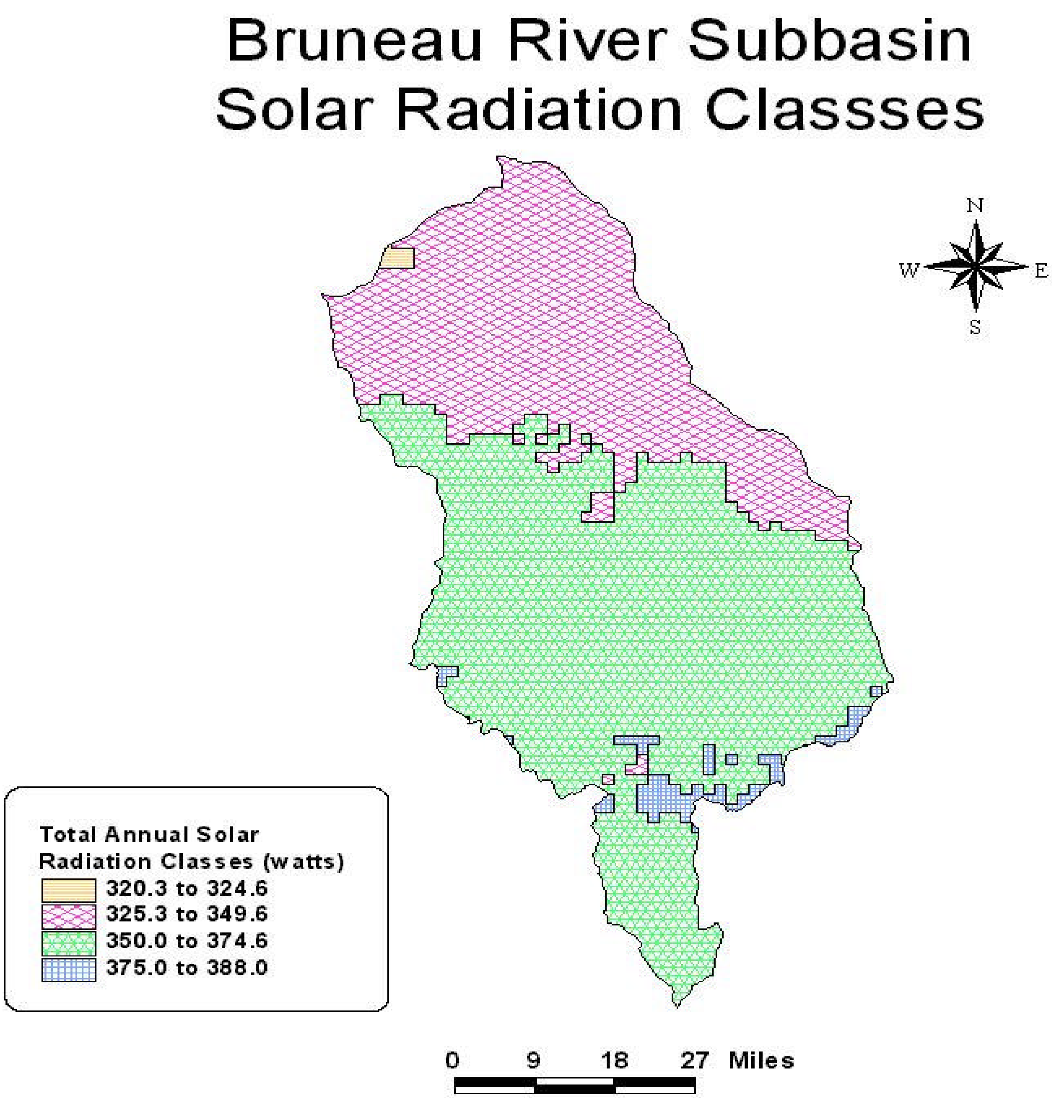


Classes	Acres	Square Miles	% of Area
30.2 - 34.4	25575.8700	39.8900	1.2
35.0 - 39.8	246283.6200	384.4800	11.6
40.4 - 44.6	1116752.1000	1744.4200	52.6
45.2 - 49.4	524709.8200	819.6000	24.7
50.0 - 52.4	209070.7400	326.6300	9.9

Prepared by Rob Sharpnack - March 2000

Source: Upper Snake Basin Ecological Classification Nov. 1999

Figure 14. Average Annual Temperature Ranges of the Bruneau River Subbasin.



Class	Acres	Square Miles	% of Area
320.3 to 324.6	5742.4400	8.9500	0.3
325.3 to 349.6	772232.3200	1204.8000	36.4
350.0 to 374.6	1290141.6100	2012.6700	60.8
375.0 to 388.0	54274.9900	84.6300	2.6

Source: Upper Snake Basin Ecological Classification Nov. 1999

Figure 15. Total Annual Solar Radiation of the Bruneau River Subbasin.

2.1.2.1 Bruneau River

The Bruneau River begins in the northeastern mountains of Nevada and flows to the confluence of the Snake River at CJ Strike Reservoir (see section 2.1.1). Throughout its 133.58 kilometer length (Idaho portion), three perennial tributaries (Sheep Creek, Jarbidge River, and Clover Creek) enter the system as do numerous intermittent and ephemeral systems. Three gauge locations can be found on the Bruneau River in Idaho. The upstream most of these locations is the gauge near Tindall, Idaho. The Tindall gauge was in operation from August 1910, until May 1912, with a contributing watershed area of 1139.6 km^2. Given this size watershed, channel characteristics can be extrapolated from regional curves. These regional curves can be found in the book *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, the Bruneau River at this sampling location would have a mean depth of 1.07 m, a bank full width of 24.38 m and a cross sectional area of approximately 27.87 m^2. From the historical gauge data, period of record average discharge at this location was 3.35 cubic meters per second (cms). Low discharge occurred during the fall quarter with only 0.70 cms. Spring discharge was 8.58 cms, while winter base discharge was 1.48 cms. Summer discharge was 2.30 cms.

The next gauge was located near Winter Camp Ranch. The period of record for this gauge was from November 1946 to September 1951. The watershed area for this gauge was 4,895 km^2. The average discharge at this gauge was 9.94 cms. The lowest average discharge occurred again in the fall at 1.80 cms. Winter base discharge averaged 3.94 cms, while during the summer the average discharge was 12.98 cms.

The final gauge location is near Hot Springs, Idaho. This location is also the beginning of the 23.24 km long §303(d) listed section of the Bruneau River. Additionally, this gauge is the only active gauge on the Bruneau River in Idaho. The period of record for this gauge is from July 1909 to February 1915 and from October 1943 to September 1998. The drainage area of the contributing watershed is 6811.68 km^2. The average discharge is 10.98 cms. Average spring discharge is 23.35 cms. Winter discharge averages 4.73 cms. Low discharge occurs in the fall and averages 2.88 cms (Figure 16).

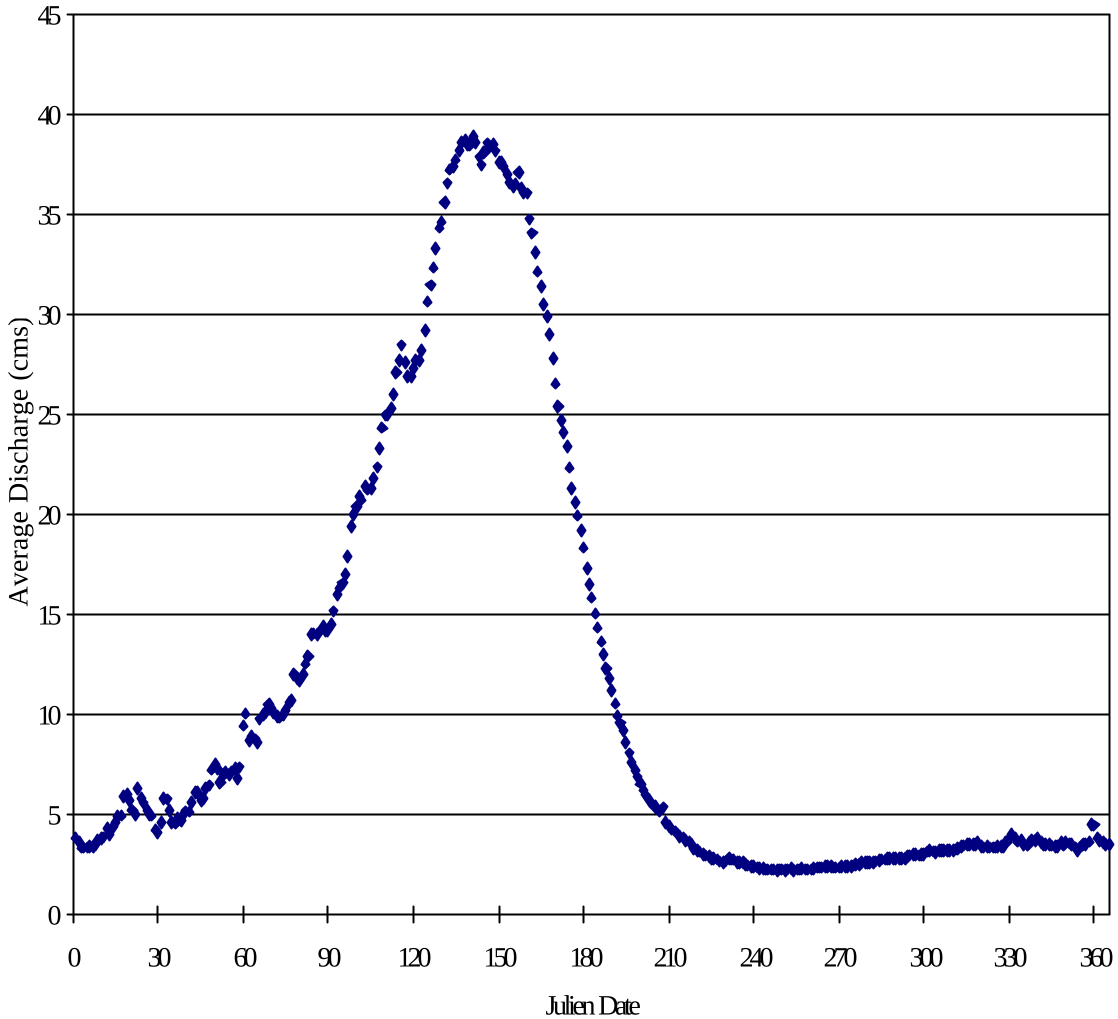


Figure 16. Daily Average Discharge for the Bruneau River, Hot Springs, Idaho Gauge.

It is unknown at this time as to the quantity of groundwater interchange in the area between the Hot Springs gauge and the mouth of the river. This area of the Bruneau River overlies the Bruneau-Grandview aquifer, so interchange to and from the river with geothermal waters does occur. Public comments received during presentations in the Bruneau area indicate that at times of the year the majority of discharge in the river is from the geothermal sources. It was indicated that geothermal waters from springs in the river near Hot Springs and large springs further up the Bruneau River canyon make up a large part of the discharge. A strong seasonal component was also indicated. Snowmelt and other runoff events in the early spring cool the river. By late spring through early fall the springs are responsible for a greater percentage of the discharge. The river is again cooled by early winter storms and runoff events.

2.1.2.2 Jacks Creek

Jacks Creek begins at the confluence of Big Jacks Creek and Little Jacks Creek. The creek is 19.81 km in length. No perennial streams enter Jacks Creek below the confluence of Big and Little Jacks Creeks. The Sugar Valley Wash, an ephemeral stream, joins Jacks Creek approximately 3.22 km above the mouth of Jacks Creeks. Jacks Creek itself is not gauged, but two gauges can be found at or near the mouths of the tributaries Big and Little Jacks Creek. Two final sources of water add to the discharge in Jacks Creek to an unknown extent. These sources are hot spring water effluent from a warm water fish hatchery and agriculture wastewater from field runoff and flowing wells. Water from these sources enters Jacks creek beginning approximately 8.05 km from the mouth. In many cases, the runoff from the agricultural fields is from geothermal wells used for irrigation. For example, a farmer in the Jacks Creek drainage noted that water from his irrigation well was applied to his fields at or near 41EC.

The upper 11.27 km of Jacks Creek is also dry for most of the year as can be seen by looking at the Big Jacks Creek Gauge data. The Big Jacks gauge period of record runs from 1938 to 1949 and from 1966 to 1998. The contributing watershed is 655.27 km^2. During the period of record, the average discharge was 0.14 cms and the average spring discharge was 0.37 cms. Winter discharge averaged 0.11 cms while summer discharge averaged 0.06 cms. Low discharge occurs in the fall and averaged 0.03 cms. The gauge was also prone to long periods of zero discharge (Figure 17). For example, in water year 1998, Big Jacks Creek was dry from October 1, 1997 until January 12, 1998, from January 22 until March 16, 1998 and from July 16 to September 5, 1998.

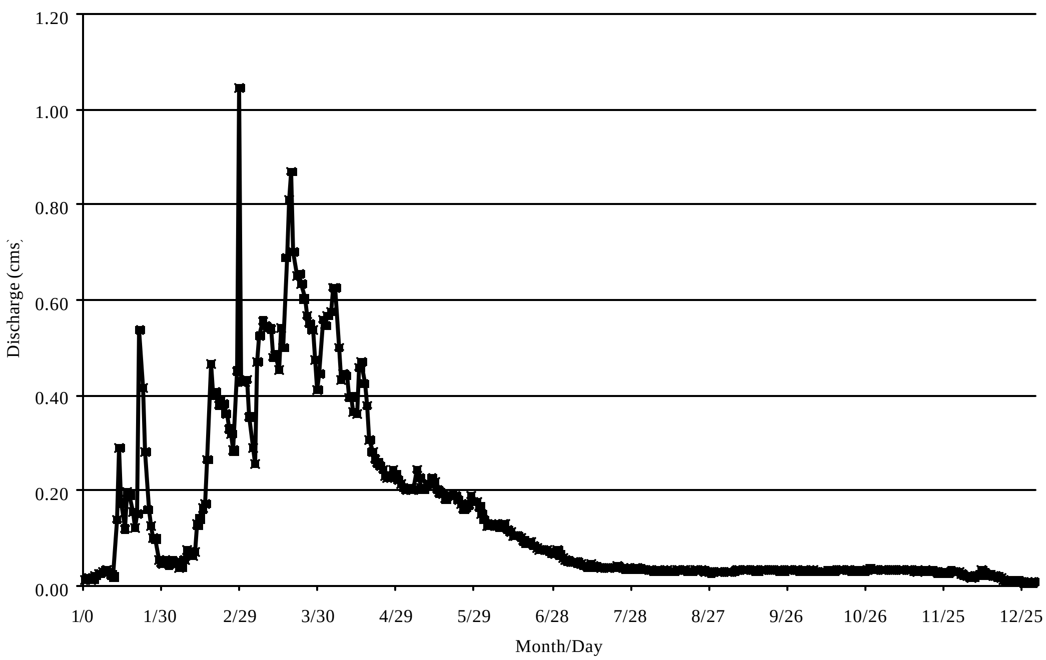


Figure 17. Daily Average Discharge in Jacks Creek.

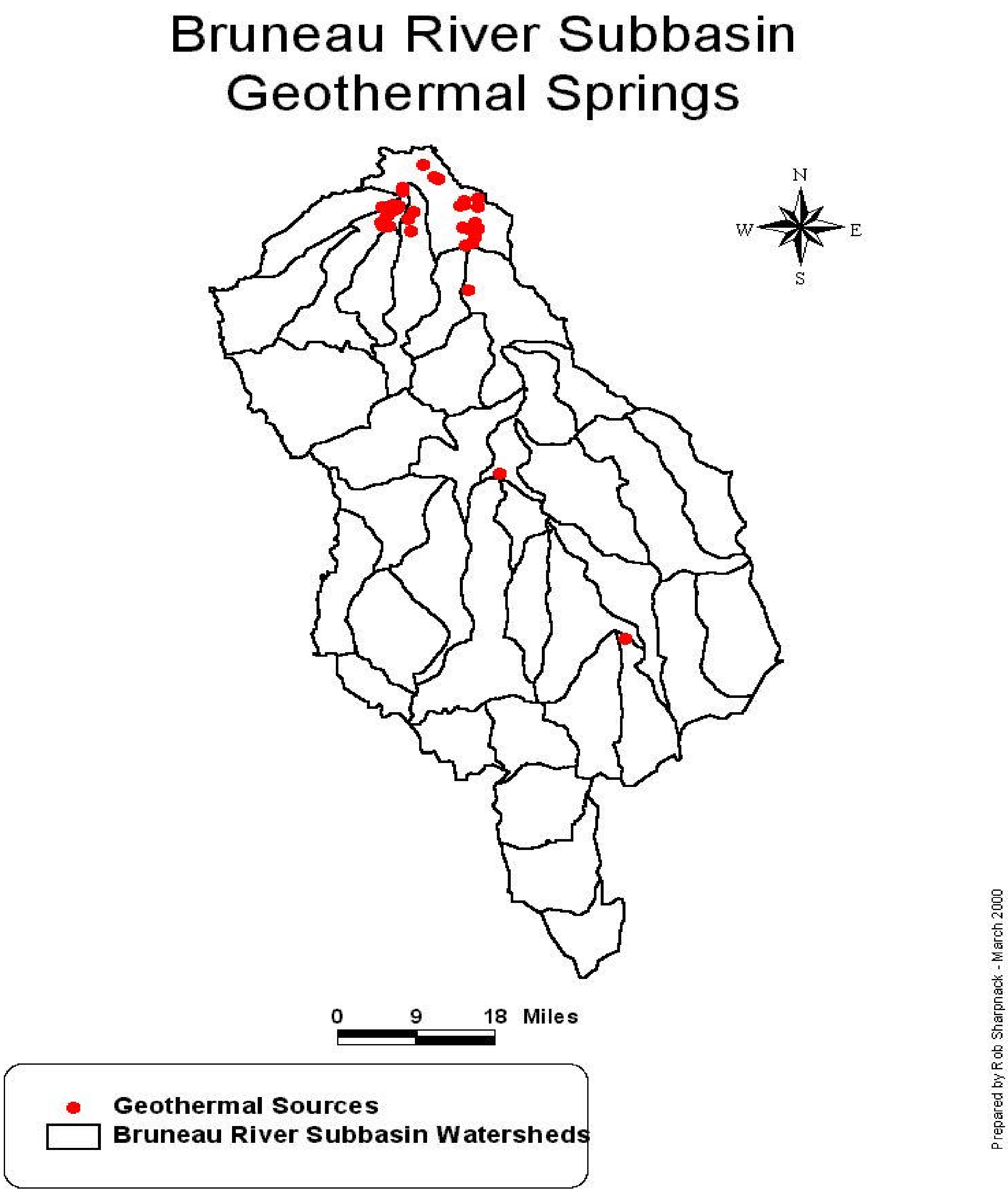


Figure 4. Geothermal Springs of the Bruneau River Subbasin.

Limited hydrologic modifications of the tributaries and of the mainstem rivers has occurred over the past several decades. These modifications include irrigation withdrawals and temporary storage structures designed to capture storm event runoff. This is most prominent in the tributary streams originating on the open plateaus. Many streams and tributaries in these areas contribute very little perennial surface flow to the mainstem rivers in this subbasin. However, intermittent and ephemeral channels proliferate in the area and impact the water quantity and quality of the mainstem rivers to an unknown extent. In addition, some losses of groundwater recharge via headcutting and the resulting loss of bank storage capabilities may have occurred in some of the perennial streams.

For these reasons, the application of the Clean Water Act in the Bruneau River Watershed is a matter of assessing the condition of the perennial stream and river systems. The conditions would be assessed under differing seasonally-influenced hydrological regimes to determine the critical periods for a river. The ephemeral and intermittent tributary creeks would then be assessed as separate entities. A final step would be to determine the effects the various thermal groundwater sources have on the rivers and streams.

2.1.1.1 Watershed Morphometry

The region is cartographically covered by 1:24,000-scale and higher USGS topographic quadrangle maps. The total vertical relief in the area is 2,583 m, from an elevation of 720 m at CJ Strike Dam to 3,303 m in the Jarbidge Mountains (Matterhorn Peak). Locally, slopes on the plateaus are usually quite gentle (although overall relief to the canyons is considerable), with considerably steeper slopes in the mountains.

The topography is chiefly an expression of the geologic structure and historical entrenchment processes. The faulted, linear mountain chains of the Basin and Range ecoregion border the Snake River Basin Plain to the south. The subbasin slopes from the south to the Snake River, which forms the northern border. The plateau areas of the subbasin generally are expanses of unintegrated depressions, low volcanic plateaus, and rough, irregular basalt flows. As stated previously; however, the area contains many intermittent and ephemeral stream systems.

The Snake River borders the subbasin on the north and has entrenched to varying depths. The Bruneau and Jarbidge rivers bisect the subbasin and flow through entrenched gorges of various depths. Small alluvial terraces rise above the rivers in limited locations. These; however, are restricted to open areas within the canyons due to the confinement of the river system within the entrenched canyons.

As stated previously the Bruneau River Subbasin covers approximately 8,546.96 km^2 in total area. Nearly 6,475 km^2, or 76 percent of the subbasin, is within the state of Idaho. The elevation range within the Idaho portion of the subbasin is from 800 to 2,300 m. The average elevation of the entire subbasin is approximately 1,470-1,770 m. The entire subbasin slope range is from less than 1 percent to 46 percent. Average subbasin slope is approximately 4 to 7 percent. Generally, the plateaus have slopes of less than 5 percent, while the river canyons and the area of the subbasin in Nevada have slopes greater than 5 percent. Overall, the subbasin has a northwest aspect. The stream channels and mainstem rivers follow a dendritic drainage pattern throughout the subbasin. In the subbasin, there are 1586.81 km of perennial streams; 4,842.52 km of ephemeral and intermittent streams; and 75.64 km of canals and ditches (Table 4). Roughly 51 percent of the perennial streams are located below 1828 meter elevation, which corresponds with the area of the subbasin located within Idaho. Approximately 83 percent of the intermittent and ephemeral streams are located in this same area.